

# STEREO/WAVES

## Interplanetary Radio Burst Tracker

Jean-Louis Bougeret, PI

Observatoire de Paris - Meudon

Science Working Group Meeting

Washington DC

27 & 28 March 2007

Observatoire de Paris

University of Minnesota

University of California - Berkeley

Goddard Space Flight Center

# STEREO/WAVES

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## Status

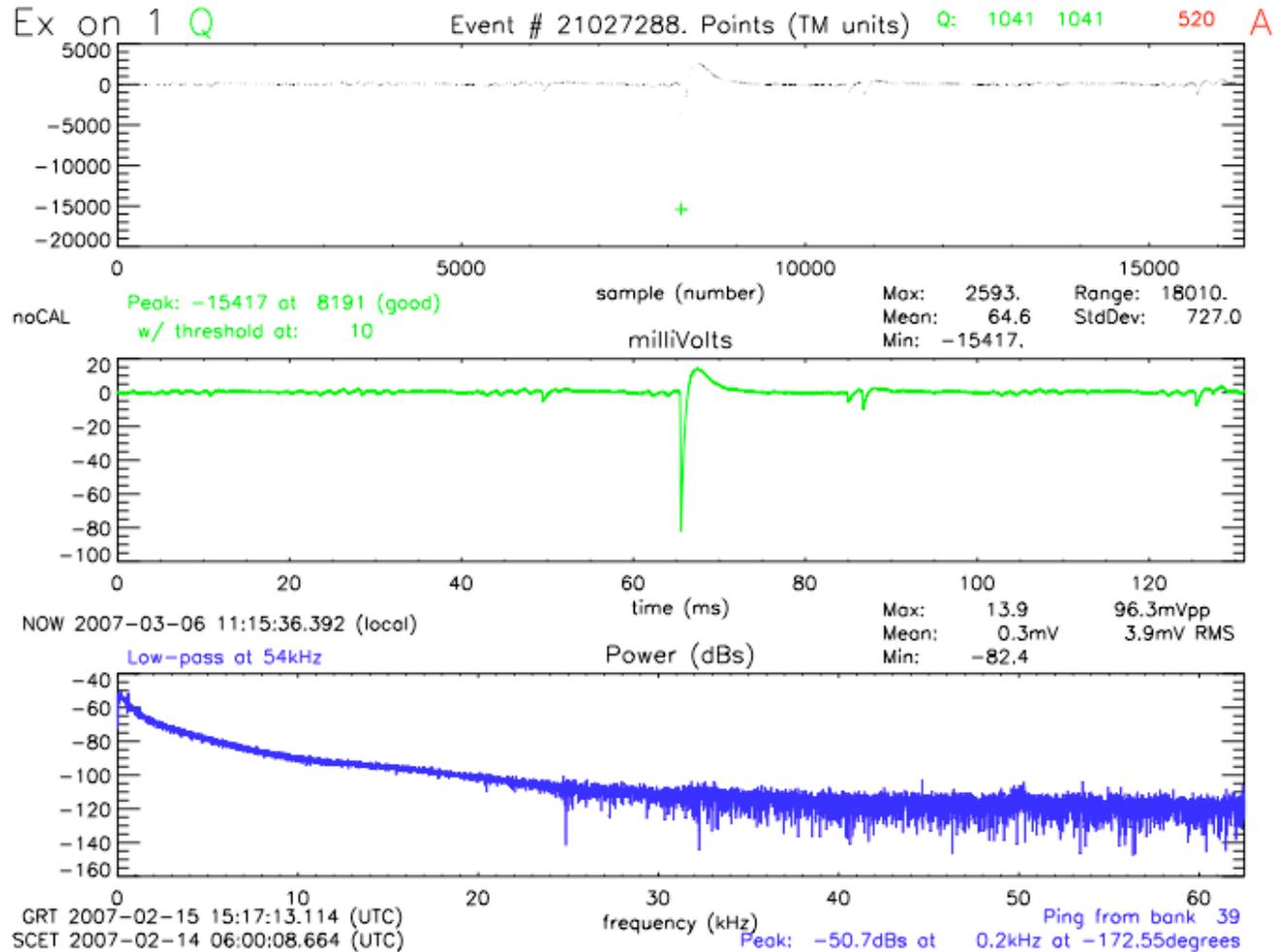
- Both receivers continue to function nominally
  - No resets
  - No trend changes in HK parameters
- 10 hour rolls completed for A and, more recently, for B
- We have been struggling to understand some transient events in the time domain
  - Often on A
  - Less often on B

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## Glitch

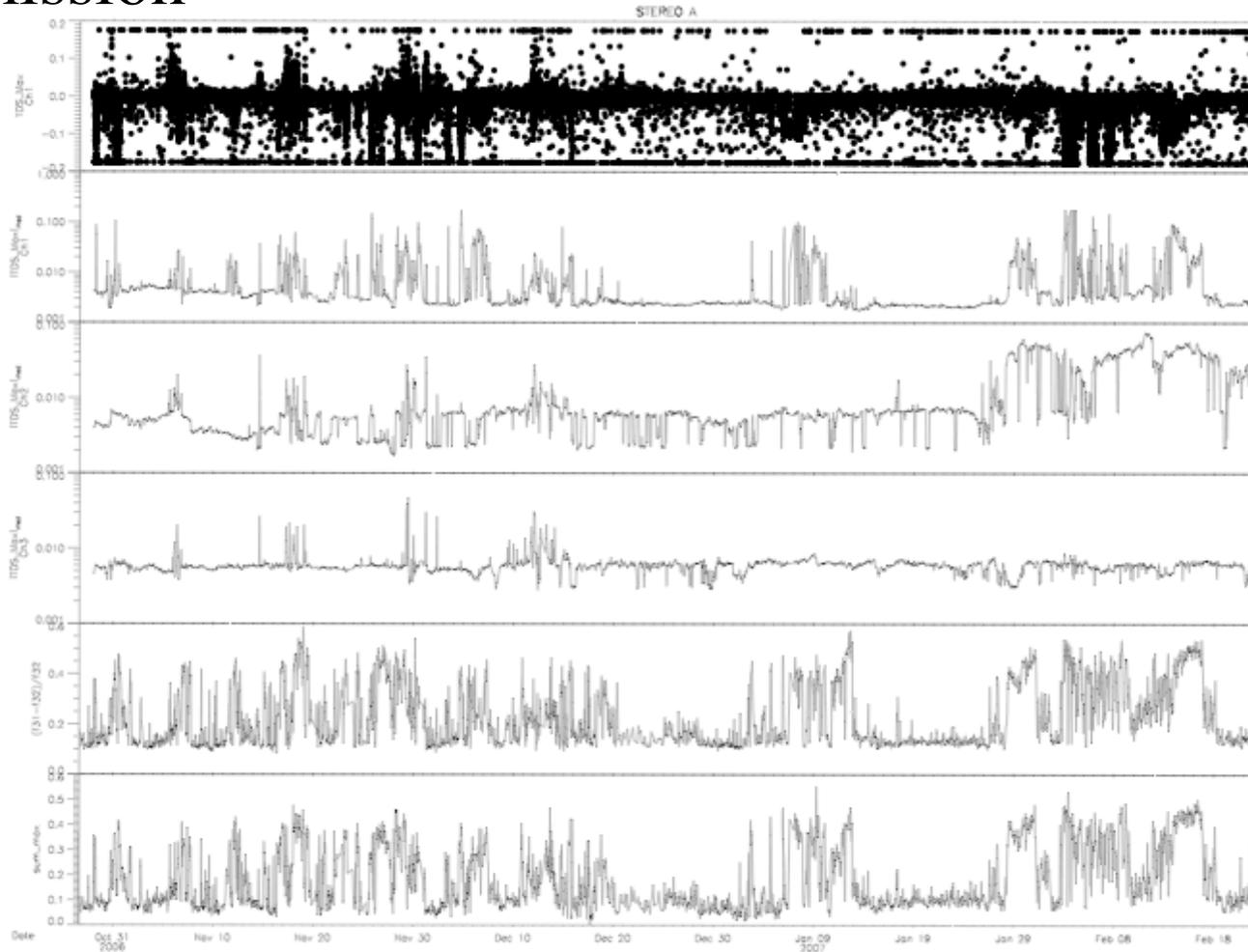


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## A mission

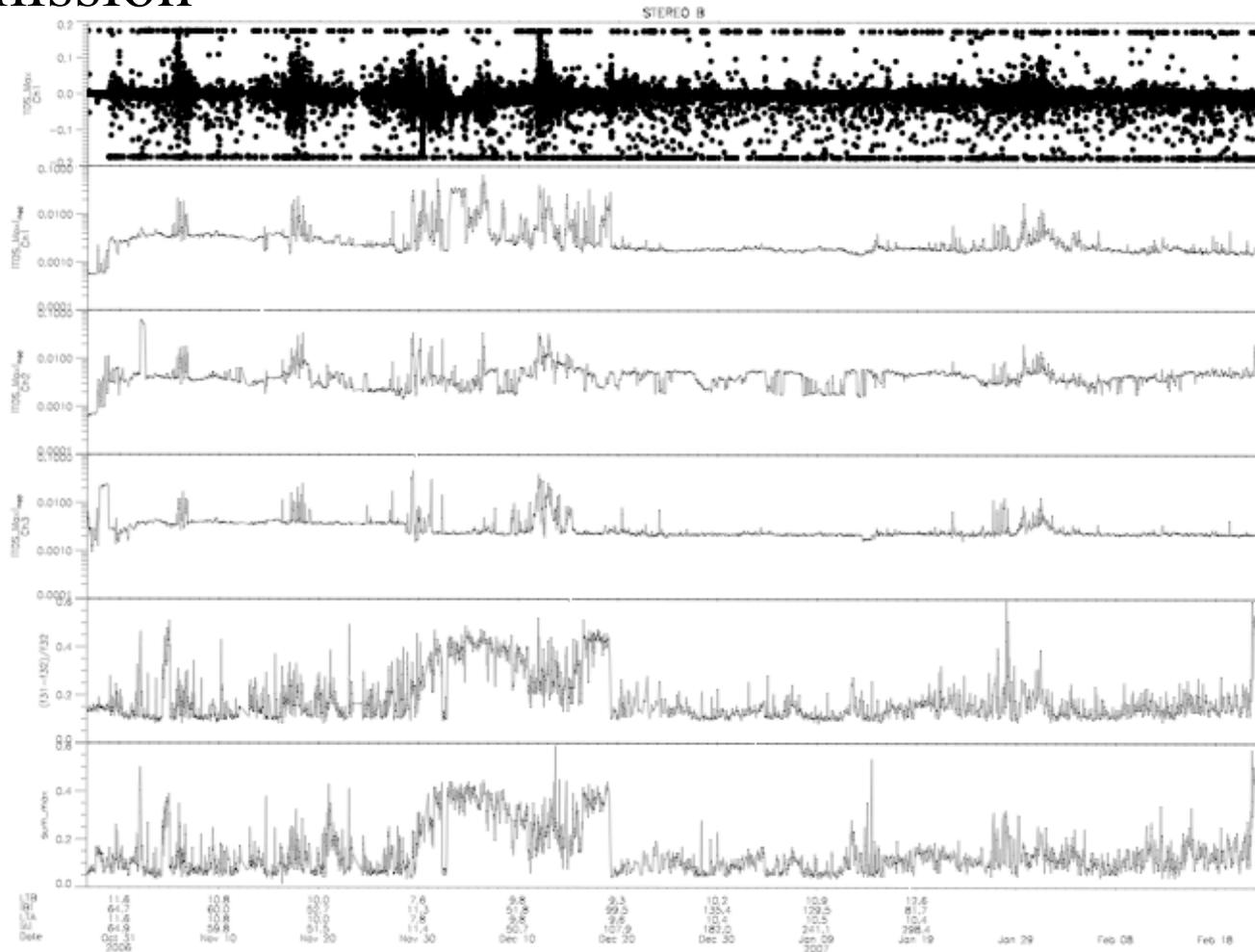


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## B mission

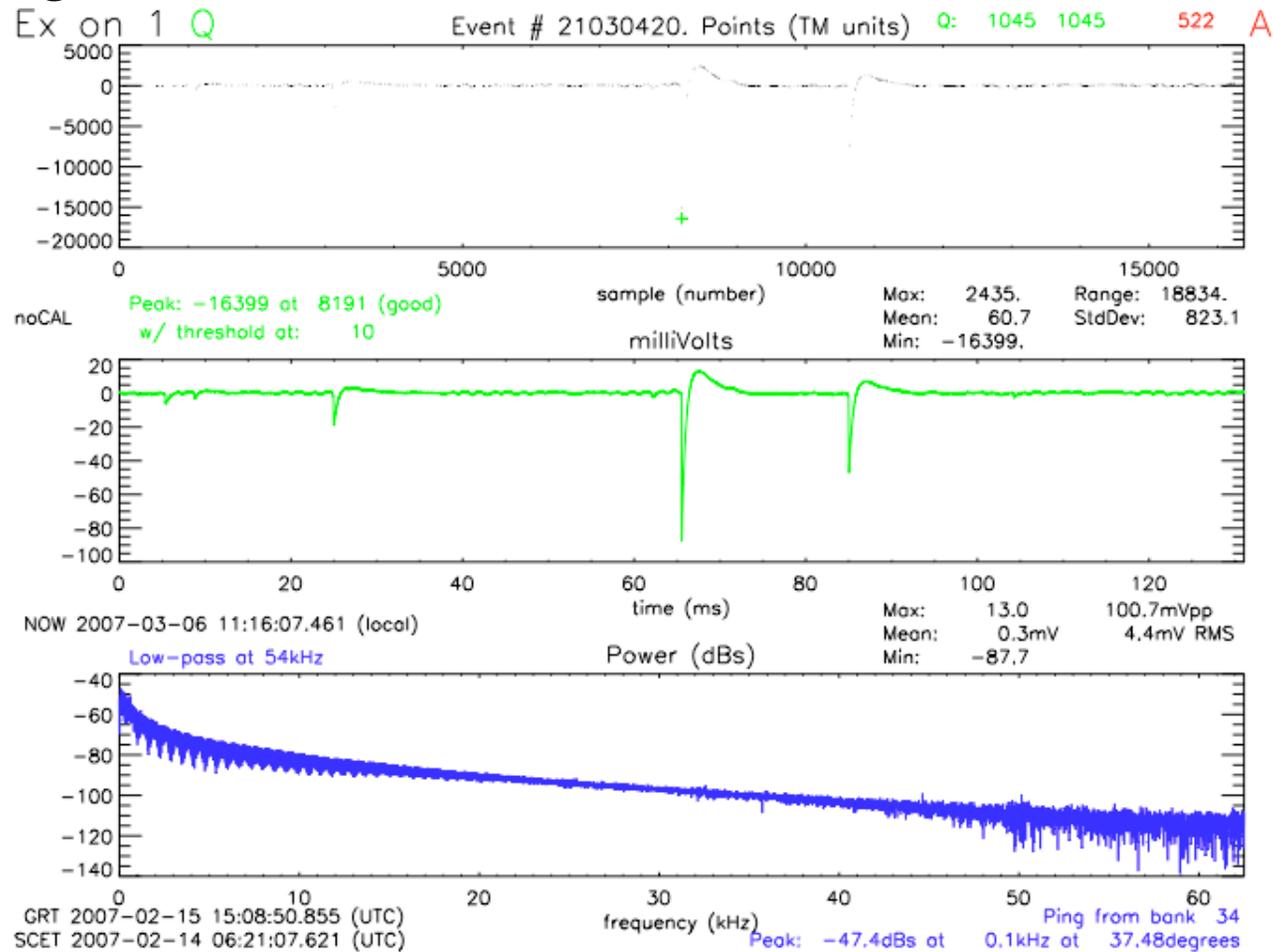


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## Hi-res glitch

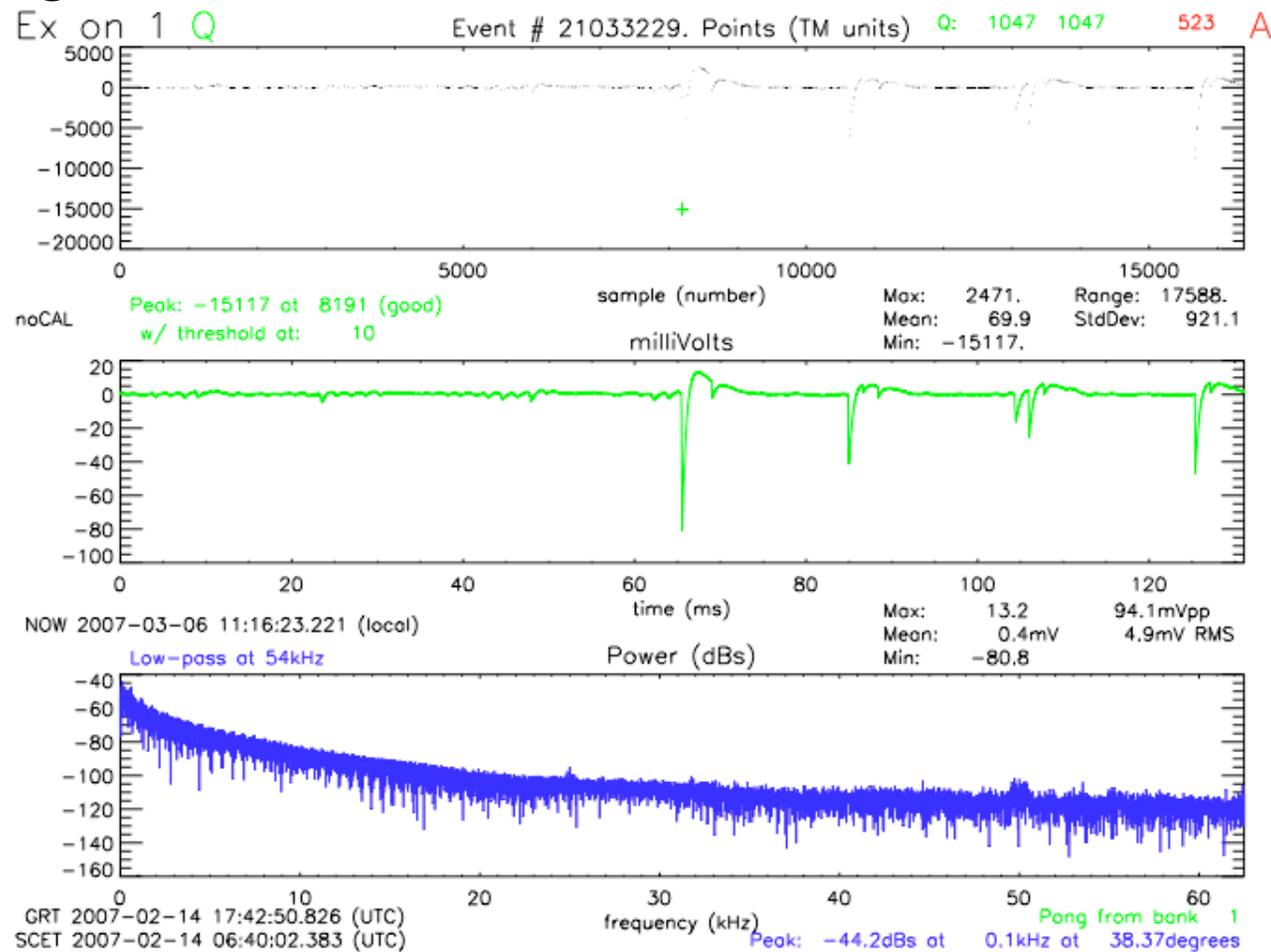


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## Hi-res glitch

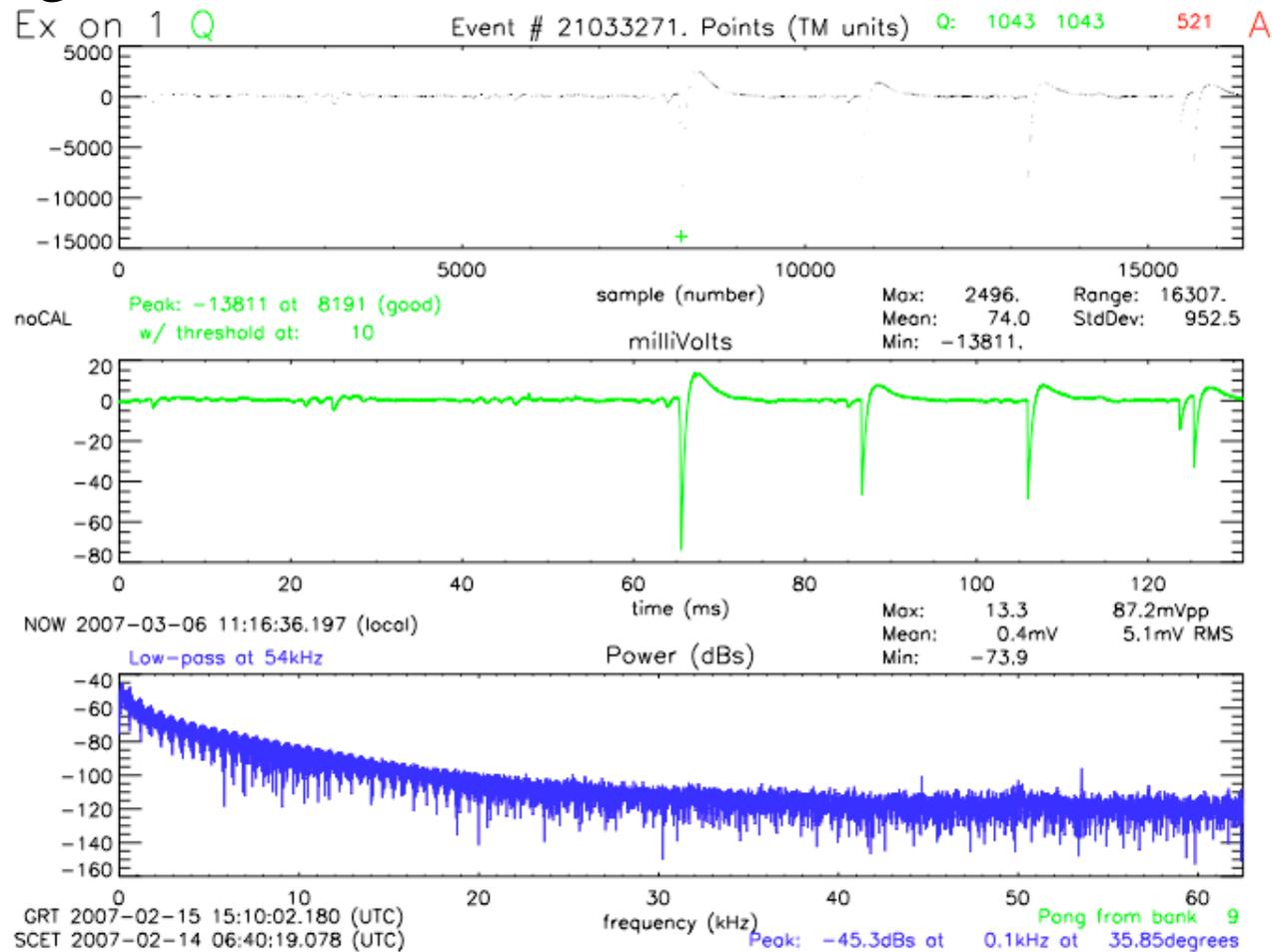


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## Hi-res glitch

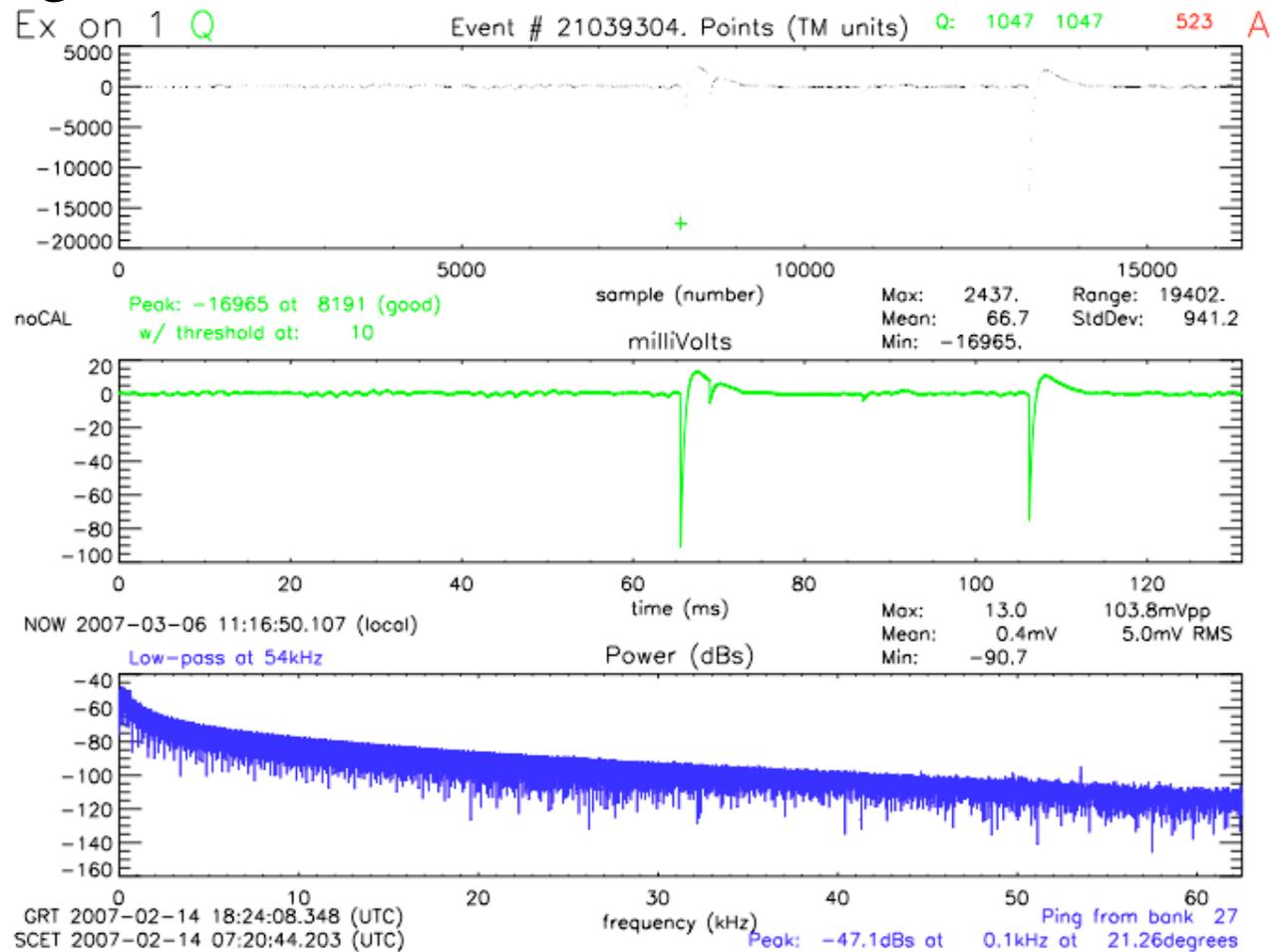


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## Hi-res glitch

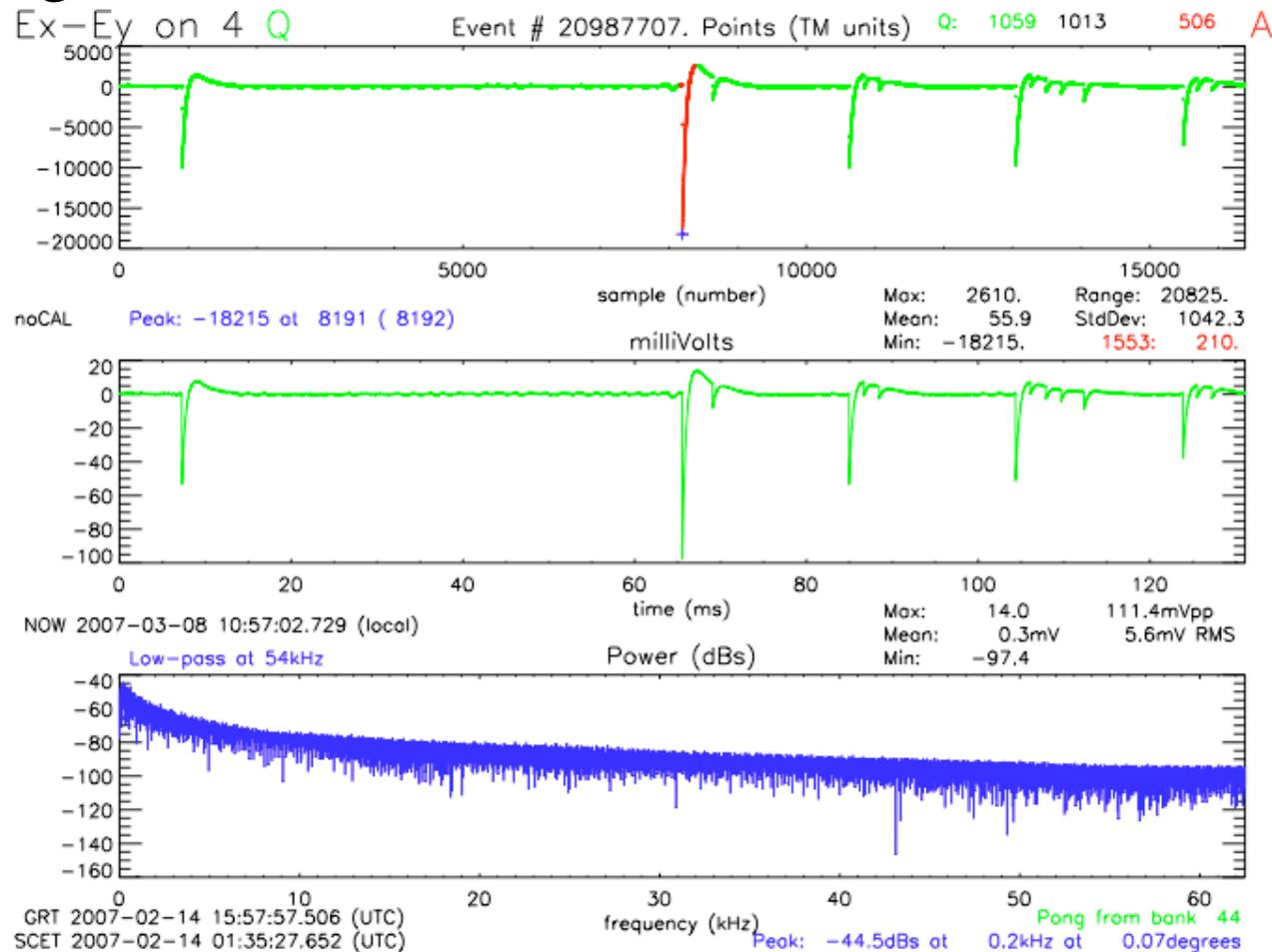


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## Hi-res glitch w/ 1553

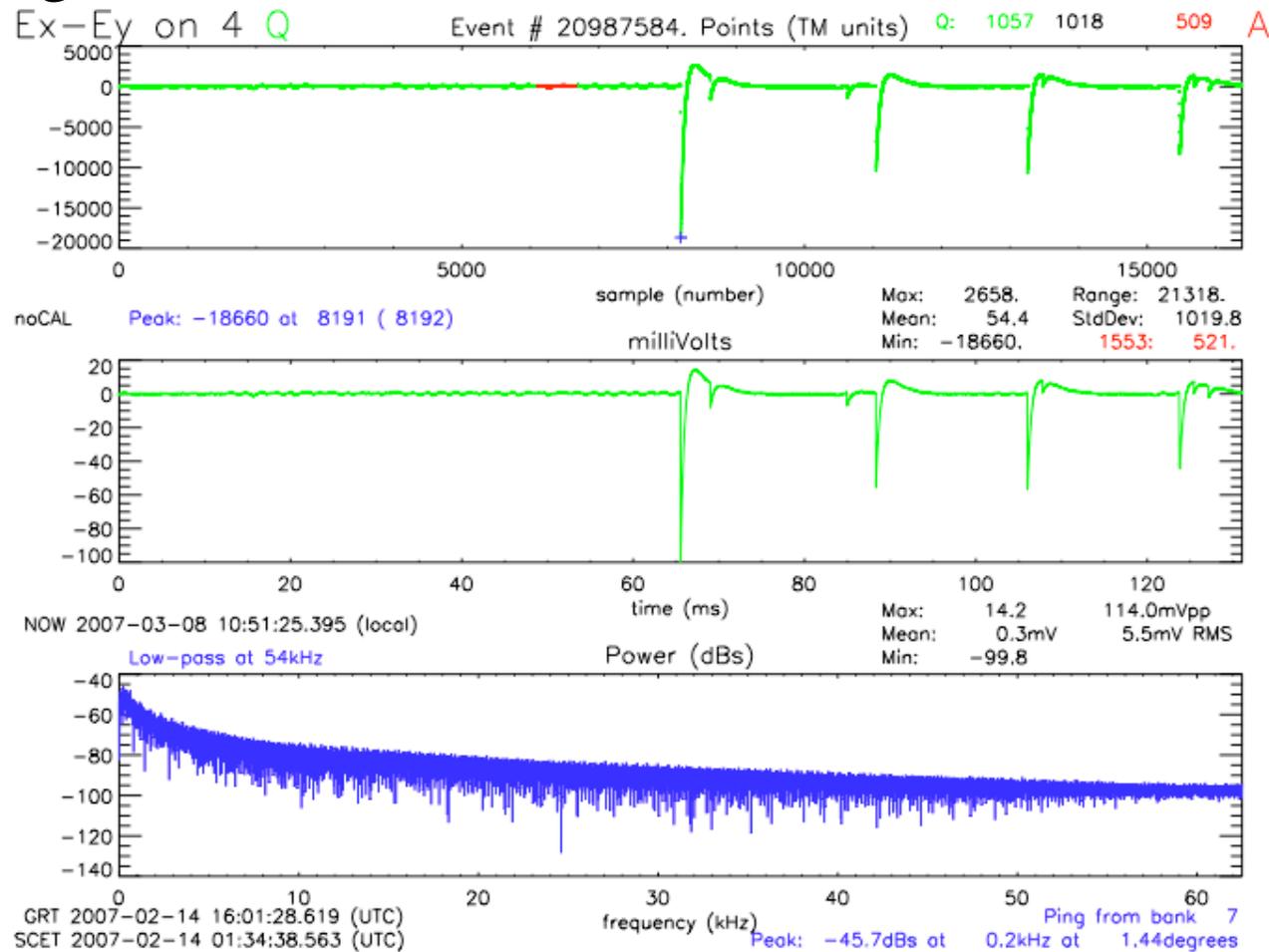


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## Hi-res glitch w/ 1553

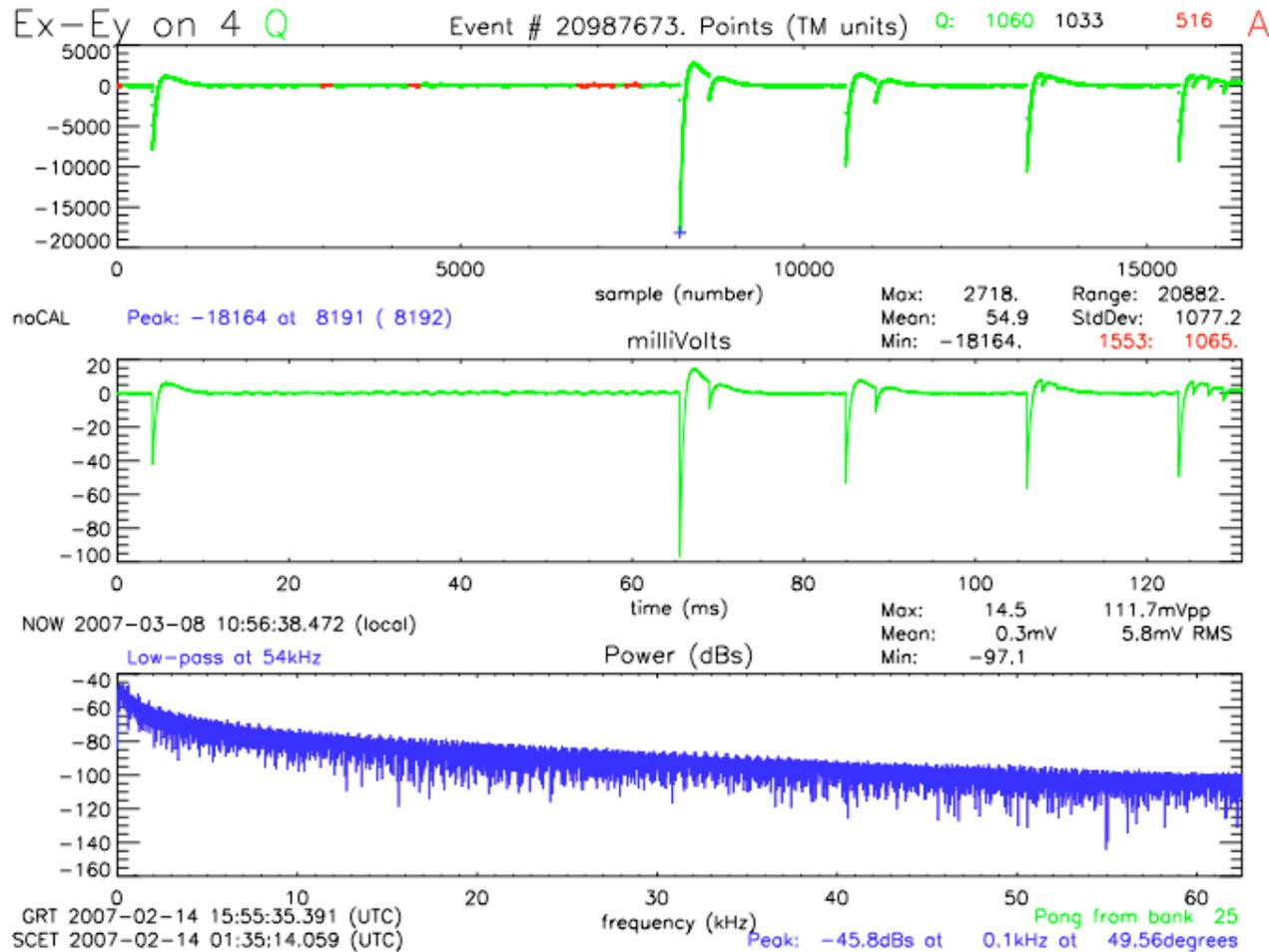


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## Hi-res glitch w/ 1553

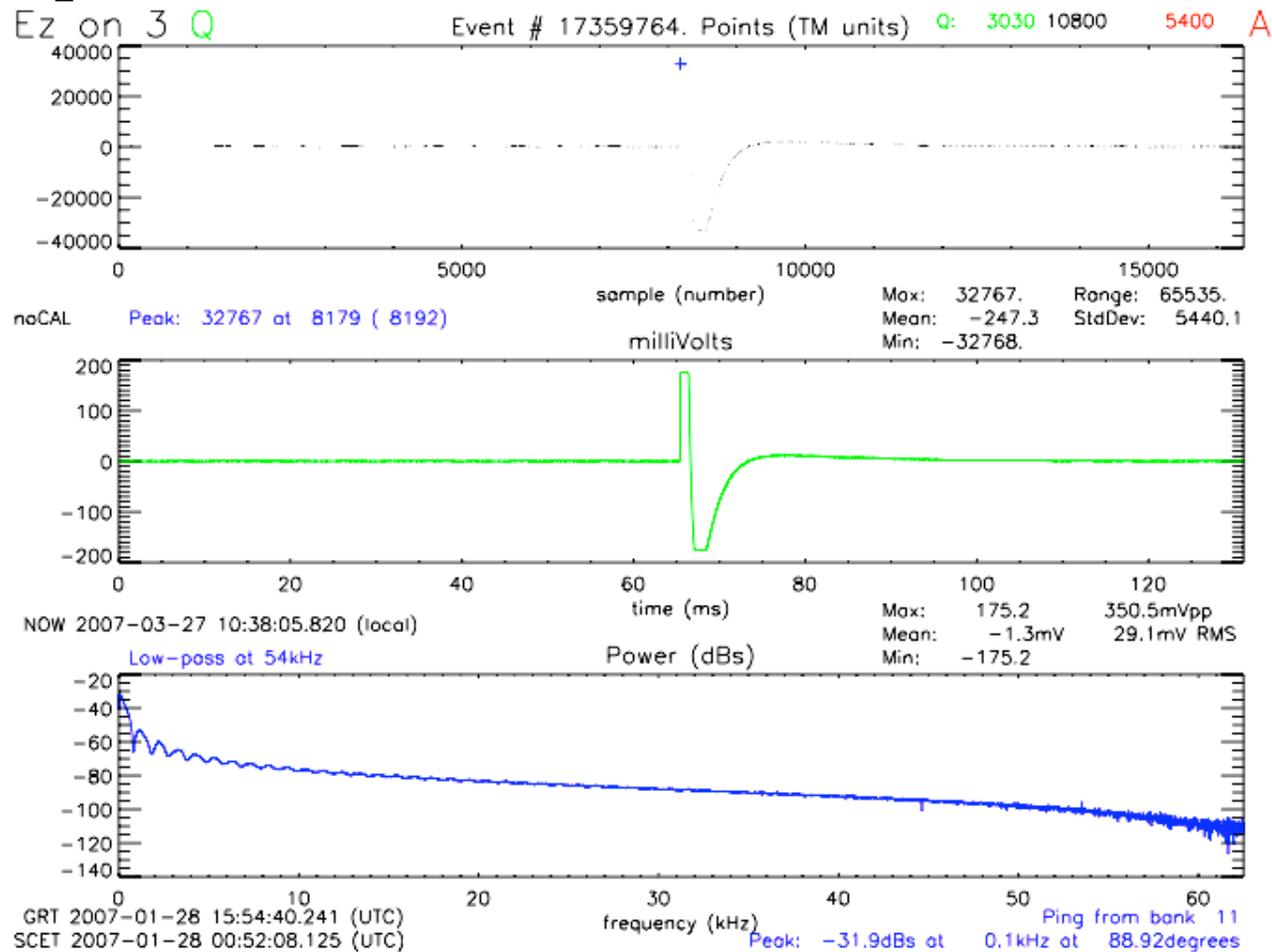


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## A big spike

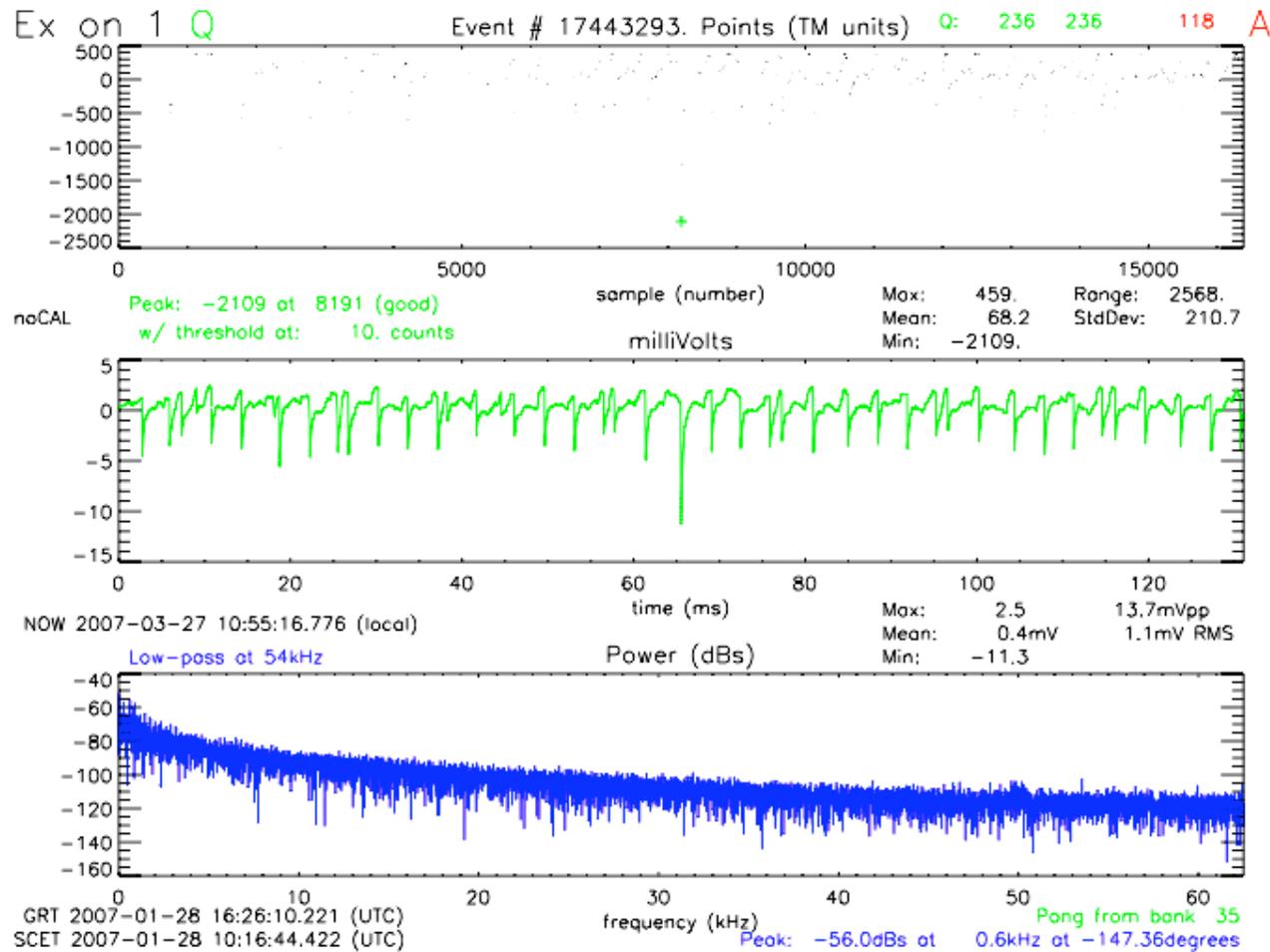


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## Lots of little friends

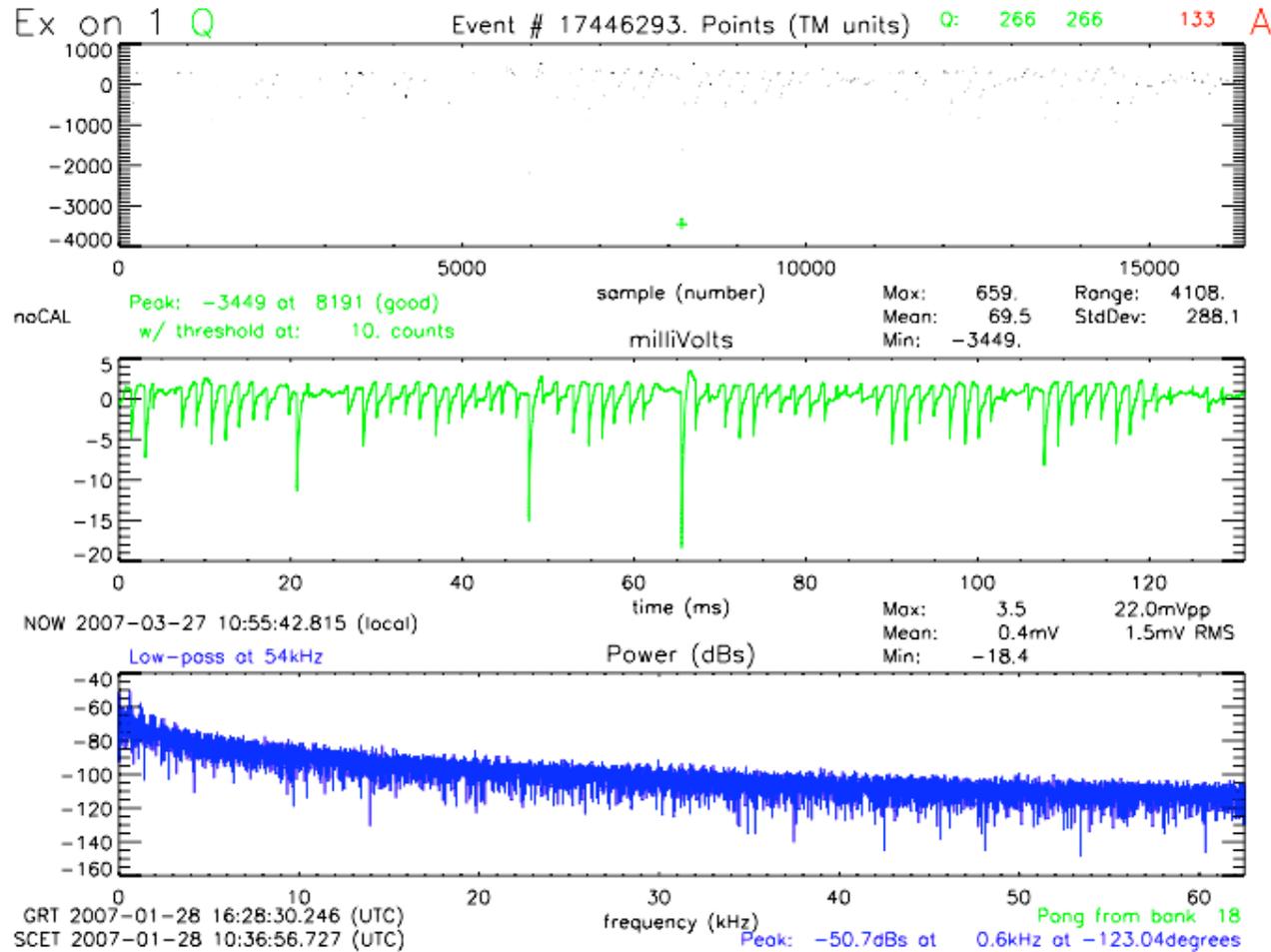


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## Lots more

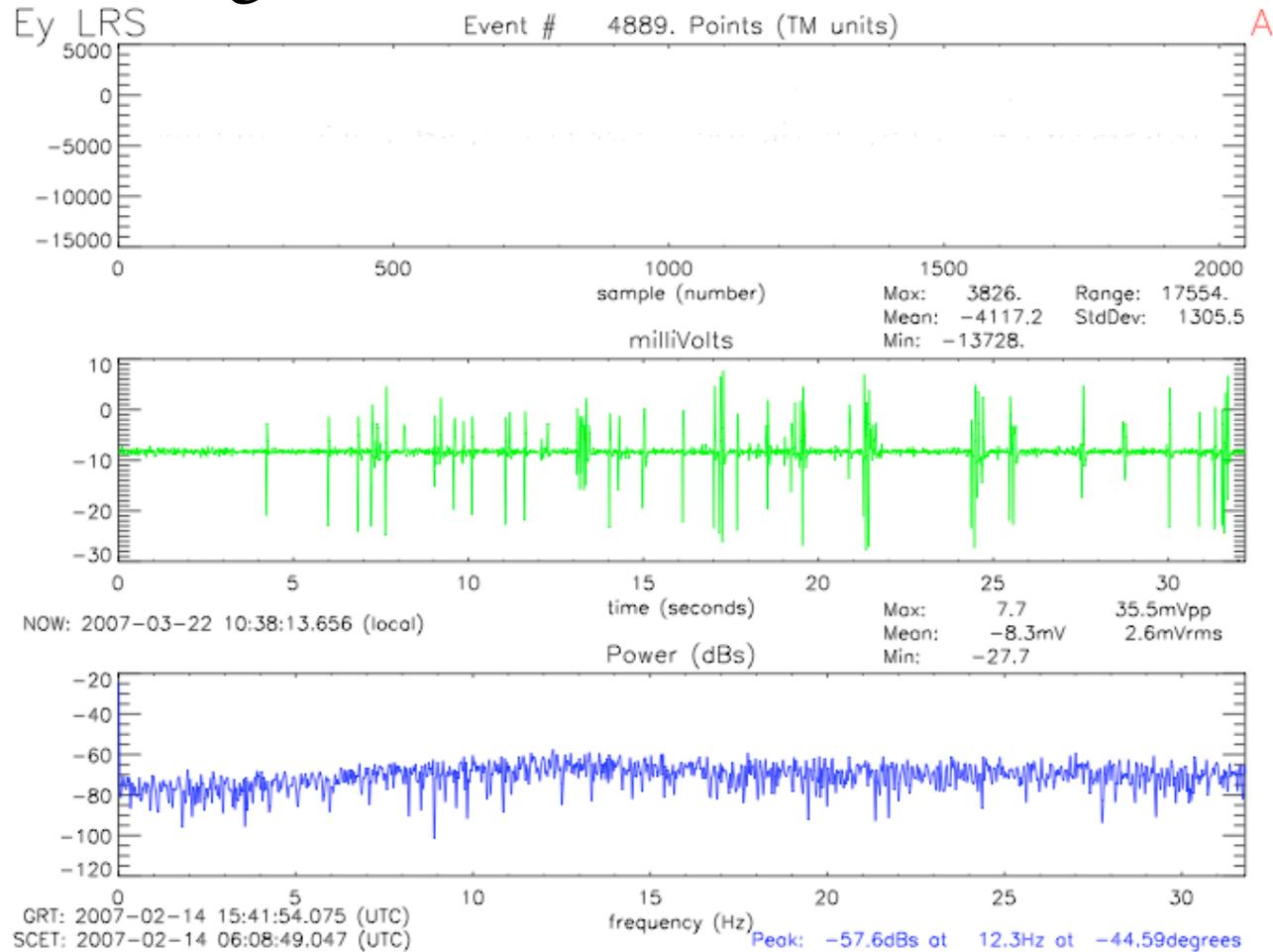


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## Medium-res glitch

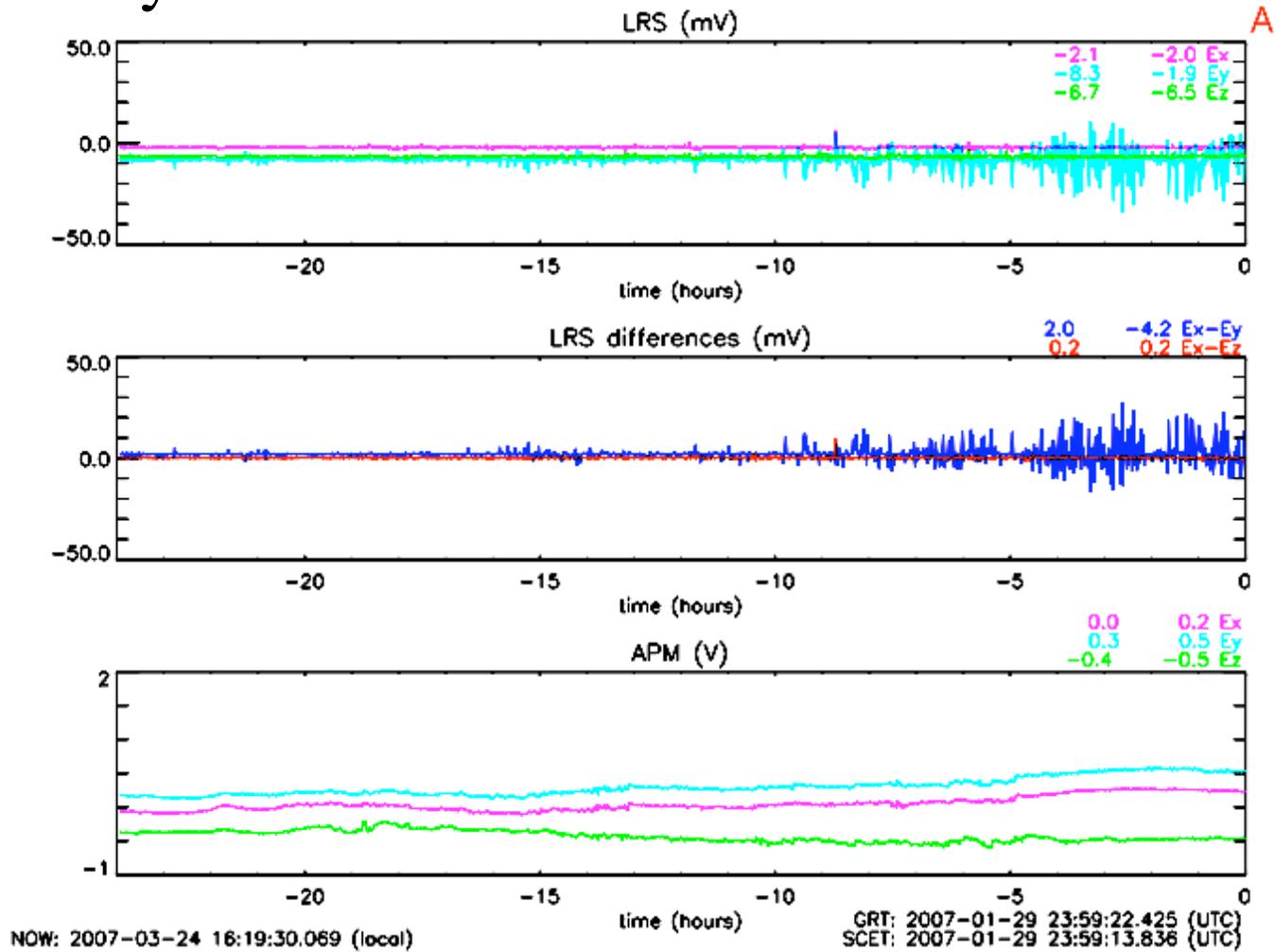


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## 29 January on A

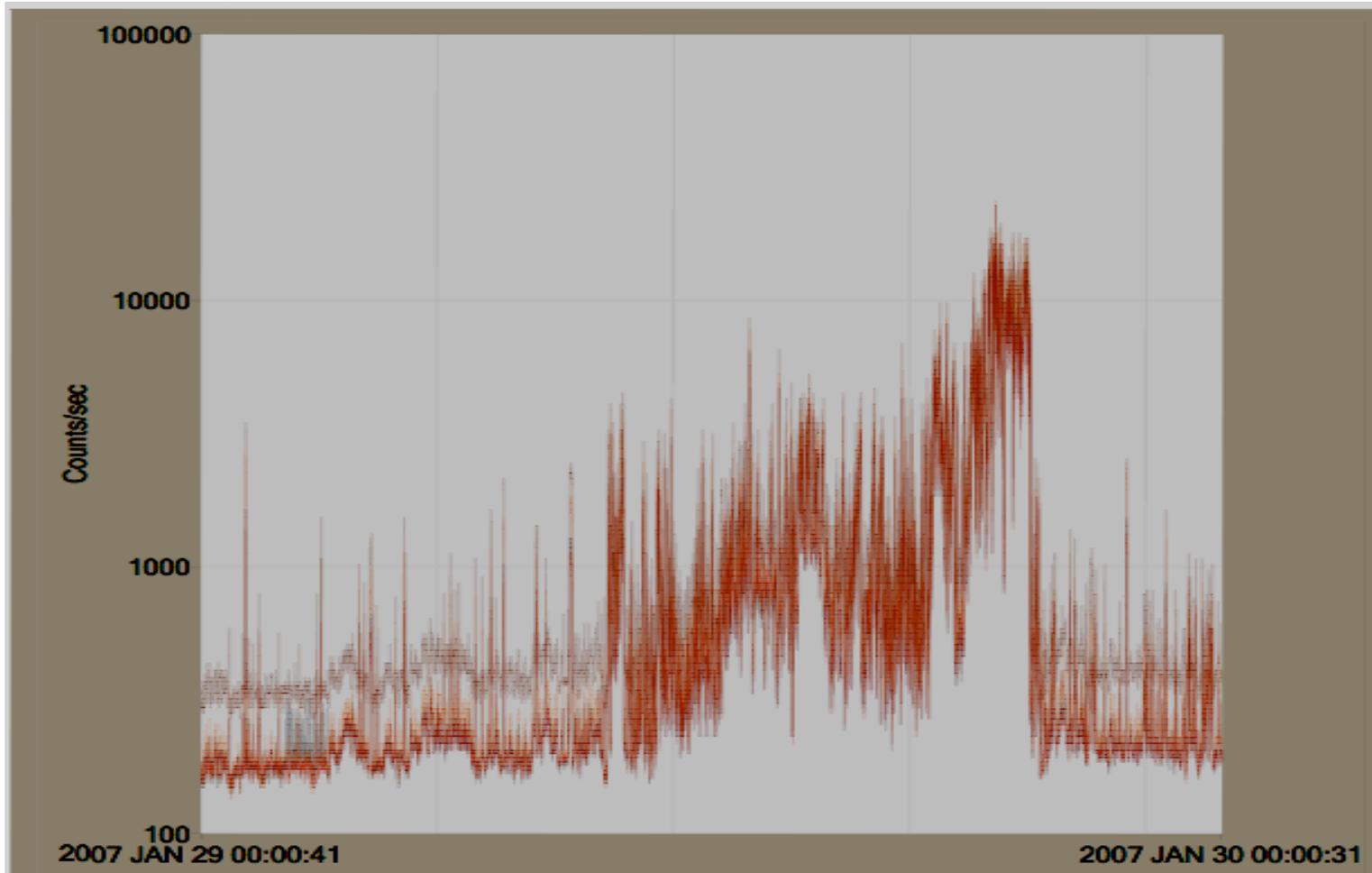


# STEREO/WAVES

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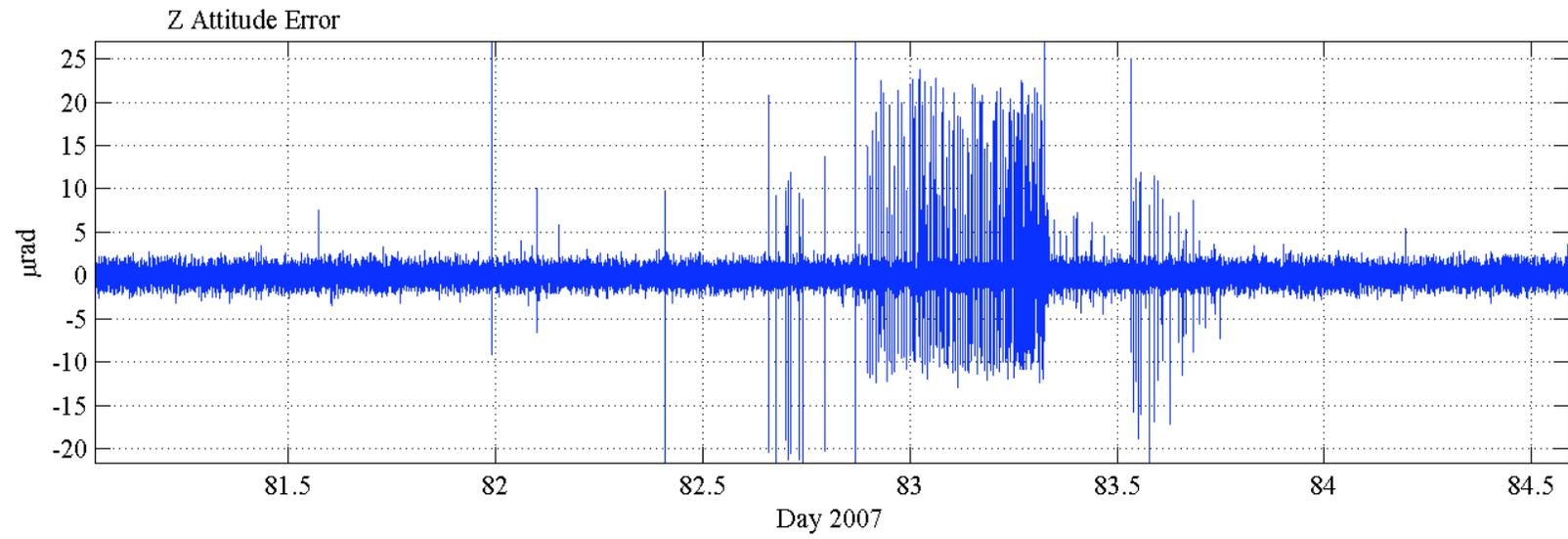
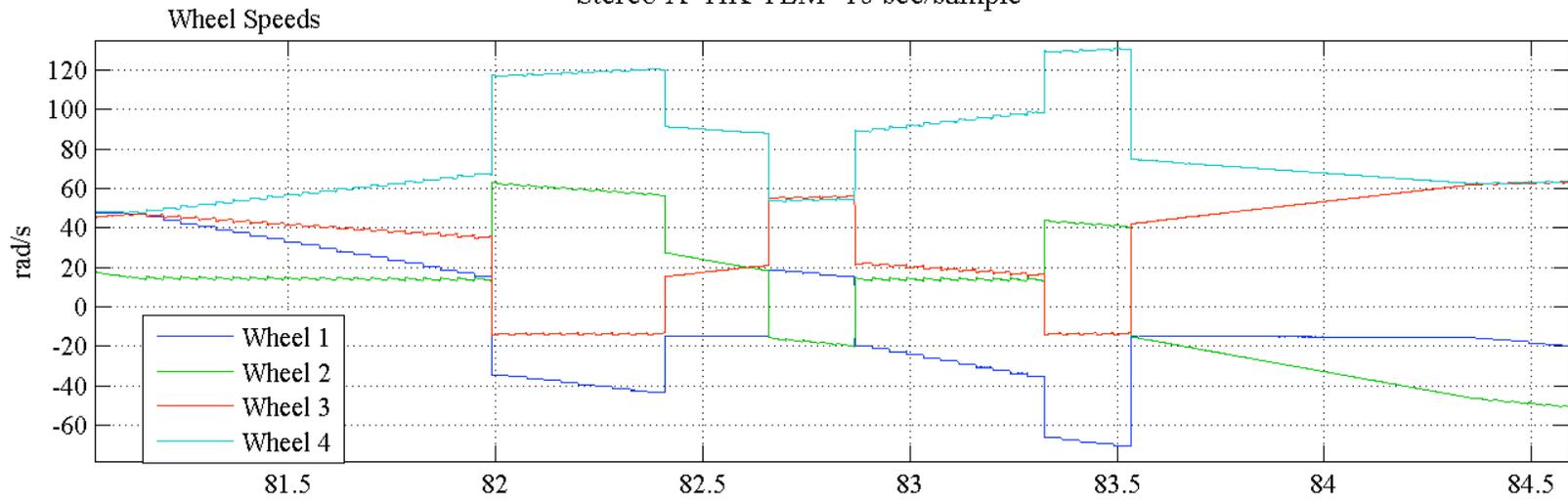
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## 29 January on A w/ IMPACT STE?



# Wheel Speeds & Attitude Spikes

Stereo A HK TLM 10 sec/sample



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## What is this?

- High voltage discharge?
- 1553 noise?
- Control system noise?
- Noise internal to S/WAVES?
- Conducted? Radiated?
  
- Never seen pre-launch
- Never seen in ground-based testing
  - TV
  - EMC
  
- So this is bothersome to S/WAVES
- We continue to get lots of interesting data but...
- More than that, one wonders what's going on - something bad?

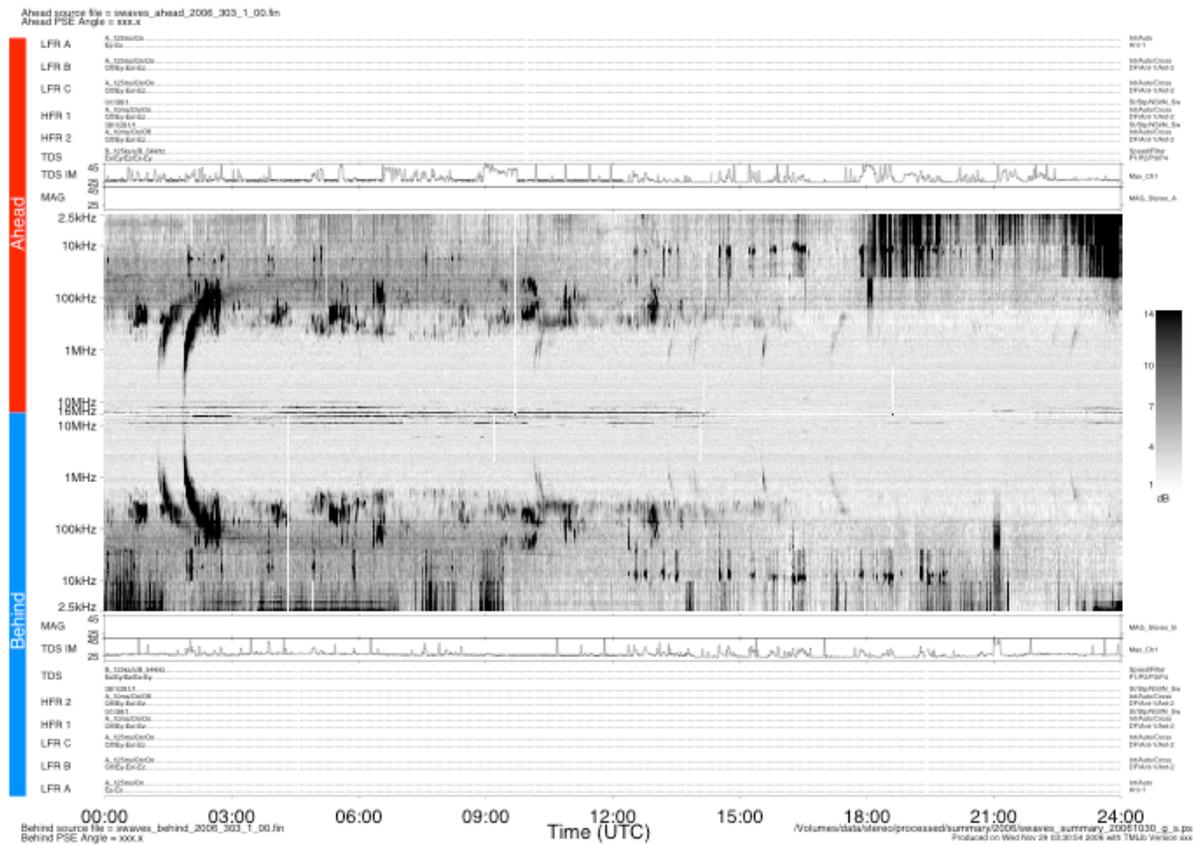
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## Daily summary plots available now (<http://swaves.gsfc.nasa.gov>)

STEREO/Waves Daily Summary - 30-Oct-2006 (303)



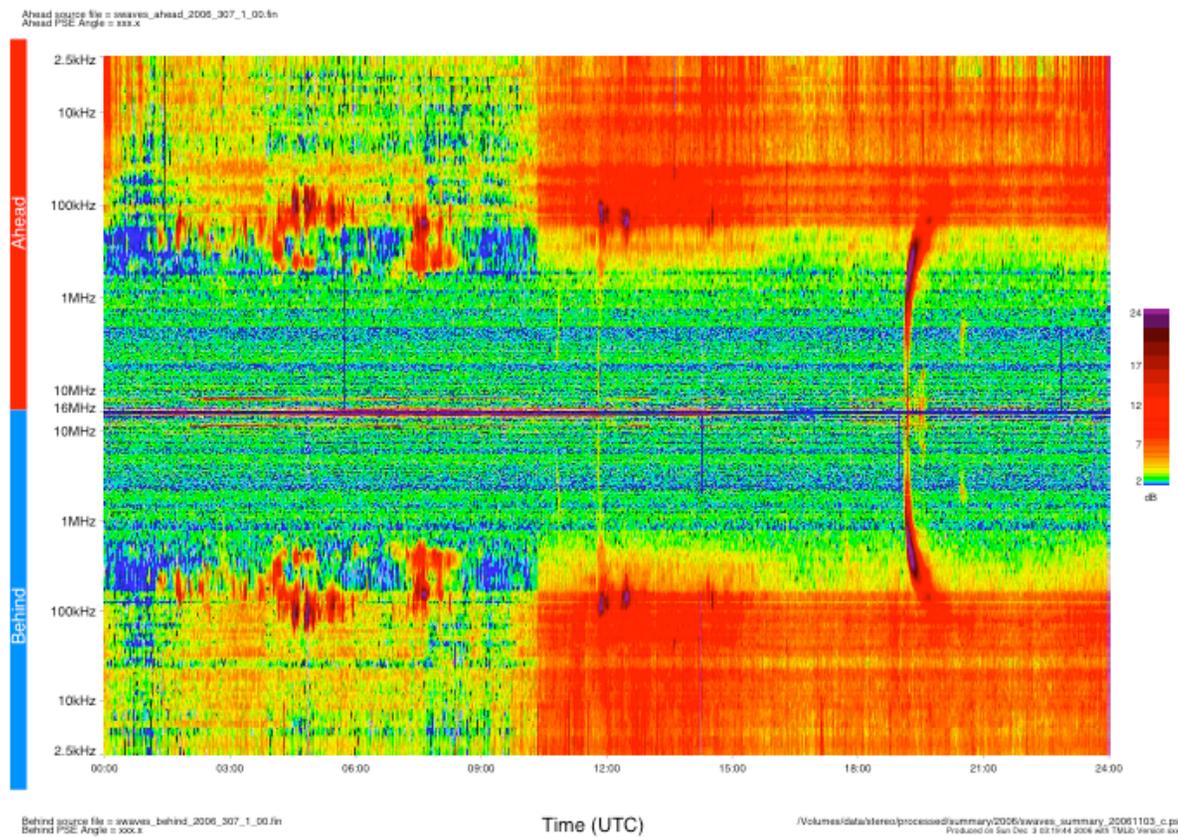
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...available in a variety of sizes and dazzling colors

STEREO/Waves Daily Summary - 03-Nov-2006 (307)



# Archiving of the SWAVES data at the CDPP (Centre de données en physique des plasmas)

- Requested for any CNES founded project
- Archived data :
  - Full resolution data in physical units for the  
    Low frequency receivers  
    High frequency receivers
  - One minute averages for LFR & HFR + ephemeris data
  - LFR & HFR dynamic spectra

binary format (ascii and possibly CDF forseen)

Routines to read the data provided in IDL, C, Matlab and Fortran

- Should be operational by May 1st
- Contact : [milan.maksimovic@obspm.fr](mailto:milan.maksimovic@obspm.fr)  
[baptiste.cecconi@obspm.fr](mailto:baptiste.cecconi@obspm.fr)



# PLASMA PHYSICS DATA CENTRE

- Data
  - Choose Data
    - By navigation
    - By keywords and criteria
    - By quicklooks
  - My Selection
    - View selection
    - Reset selection
    - Previous orders
    - Saved orders
  - My workspace
- Services
  - Documents
  - Event tables
  - Orbit viewer
- User
  - Logout
  - Update profile
  - Change password
  - License
  - Contact

You are here : [Start page](#) → [Data selection](#)

**Datasets** archived at CDPD are listed below (sorted by **missions** then **experiments** or **instruments**). Information related to a mission, an experiment or an instrument is available on its name.

## Data selection

Please select the data sets to order in the tree below.

- Missions
  - ARCAD-3 Mission
  - CLUSTER Mission
  - DEMETER Mission
  - European GEOS Mission
  - INTERBALL Auroral and Tail Mission
  - ISEE3/ICE Mission
  - STEREO Mission
    - SWAVES Experiment
      - DEF\_H\_RES : Definitive High Resolution Data (LFR, HFR and FFR Receivers)
      - DEF\_AVERAGE : Definitive Averaged Data (LFR and HFR Receivers)
      - DEF\_GRAPHS : Definitive Graphs (Dynamic Spectra)
      - PRE\_H\_RES : Preliminary High Resolution Data (LFR, HFR and FFR Receivers)
      - PRE\_AVERAGE : Preliminary Averaged Data (LFR and HFR Receivers)
      - PRE\_GRAPHS : Preliminary Graphs (Dynamic Spectra)
  - ULYSSES Mission
  - Swedish VIKING Mission
  - WIND Mission
  - EISCAT Radars
  - Geomagnetic Indices

**SWAVES data**

## Selection criteria

# The solar monitoring Web site

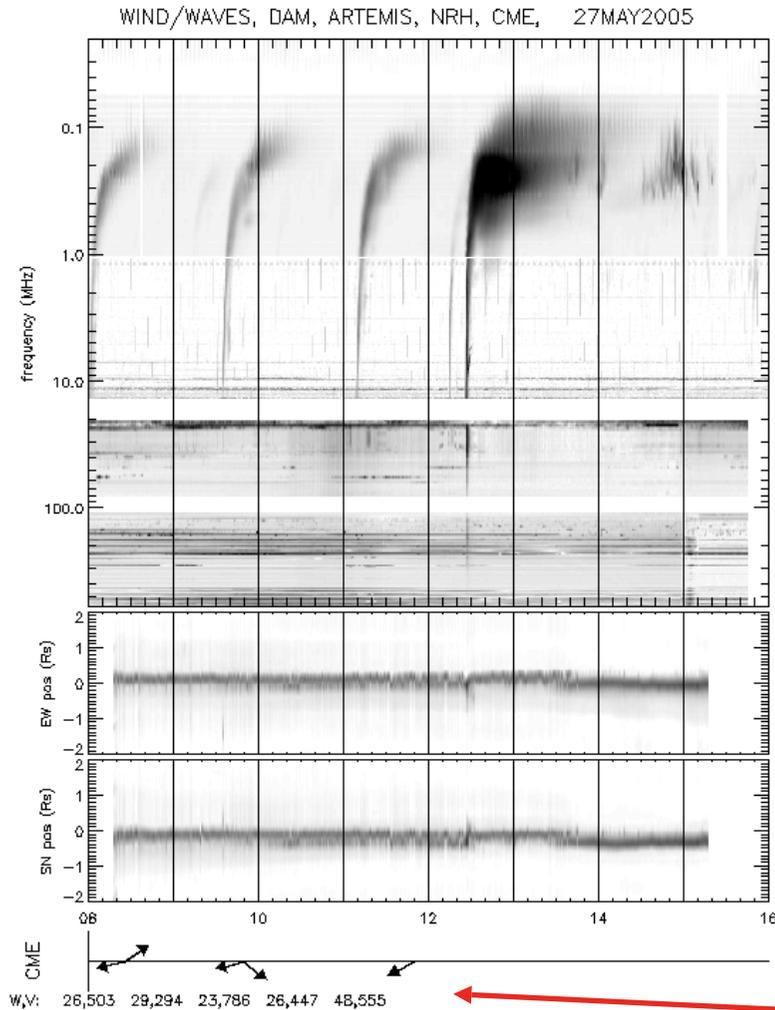
<http://secchirh.obspm.fr>



## RADIO MONITORING

- Home
- Data products
  - Characteristics
  - Products
  - Download NRH data
  - Download Artemis data
- NRH Real Time display
- Radio Instruments
  - Wind/Waves
  - DAM
  - Artemis
  - NRH
- Coronal Mass Ejections
- Gallery
- Publications
- Related links
- Survey team

Contacts :  
A. Bouteille  
M. Pick  
R. Romagnan



Assembled the 19OCT2006

- new day
- ZOOM 08h -> 09h
- ZOOM 09h -> 10h
- ZOOM 10h -> 11h
- ZOOM 11h -> 12h
- ZOOM 12h -> 13h
- ZOOM 13h -> 14h
- ZOOM 14h -> 15h
- ZOOM 15h -> 16h
- Next Day
- Prev Day

Movies :

Beginning hour : HH:MM

Frame rate :

120 secs/frame

nb of images :

120

MOVIE

Zooms

Waves

DAM

Artémis

EW

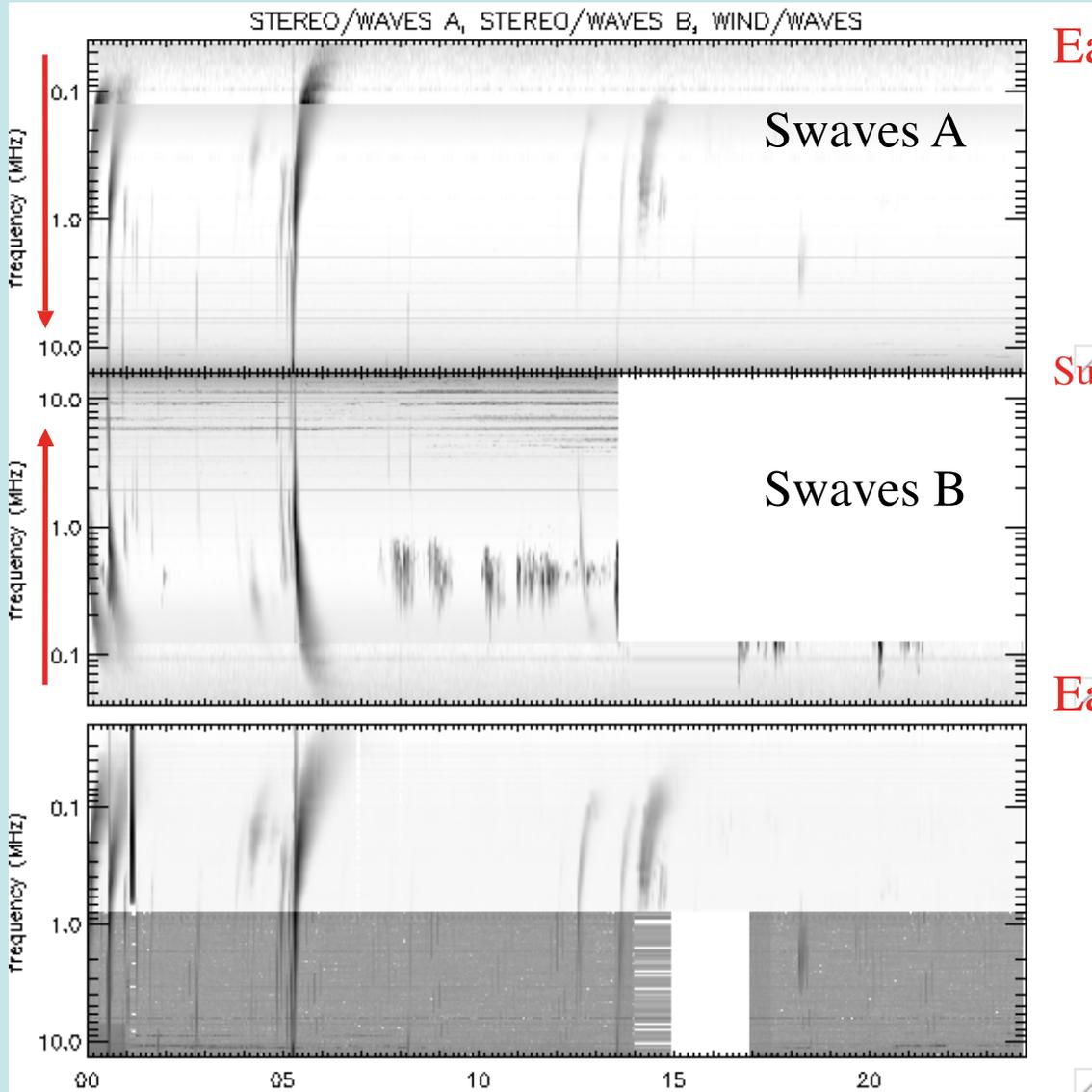
NRH

NS

Movies

CME width and speed

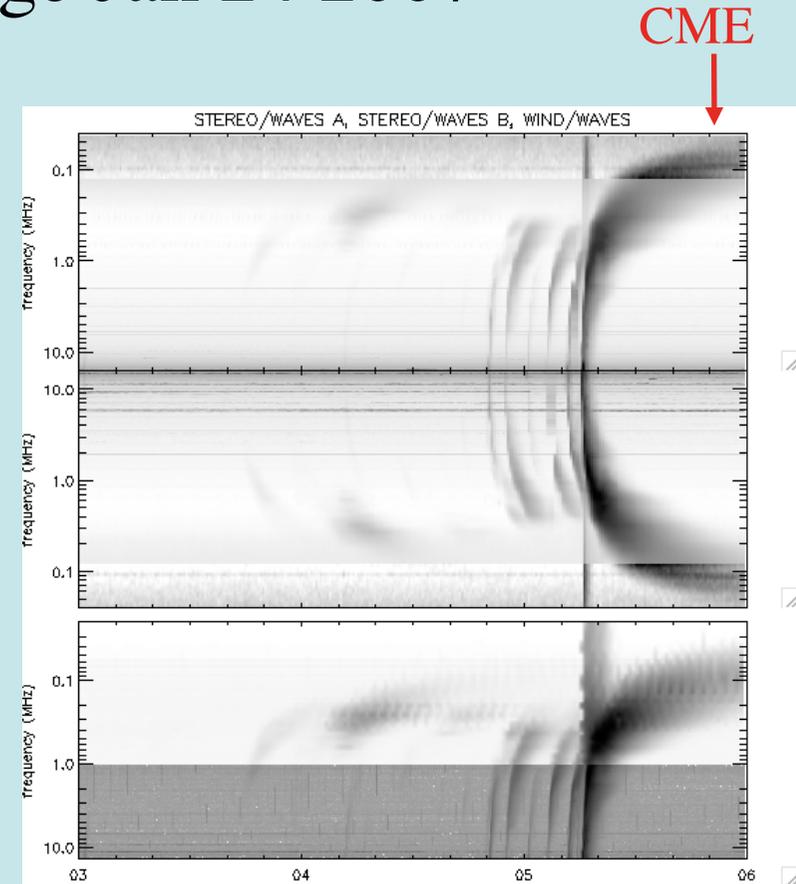
# S/Waves Waves 24 hours web page Jan 24 2007



Earth

Sun 2R.

Earth



Zoom (3 hours)

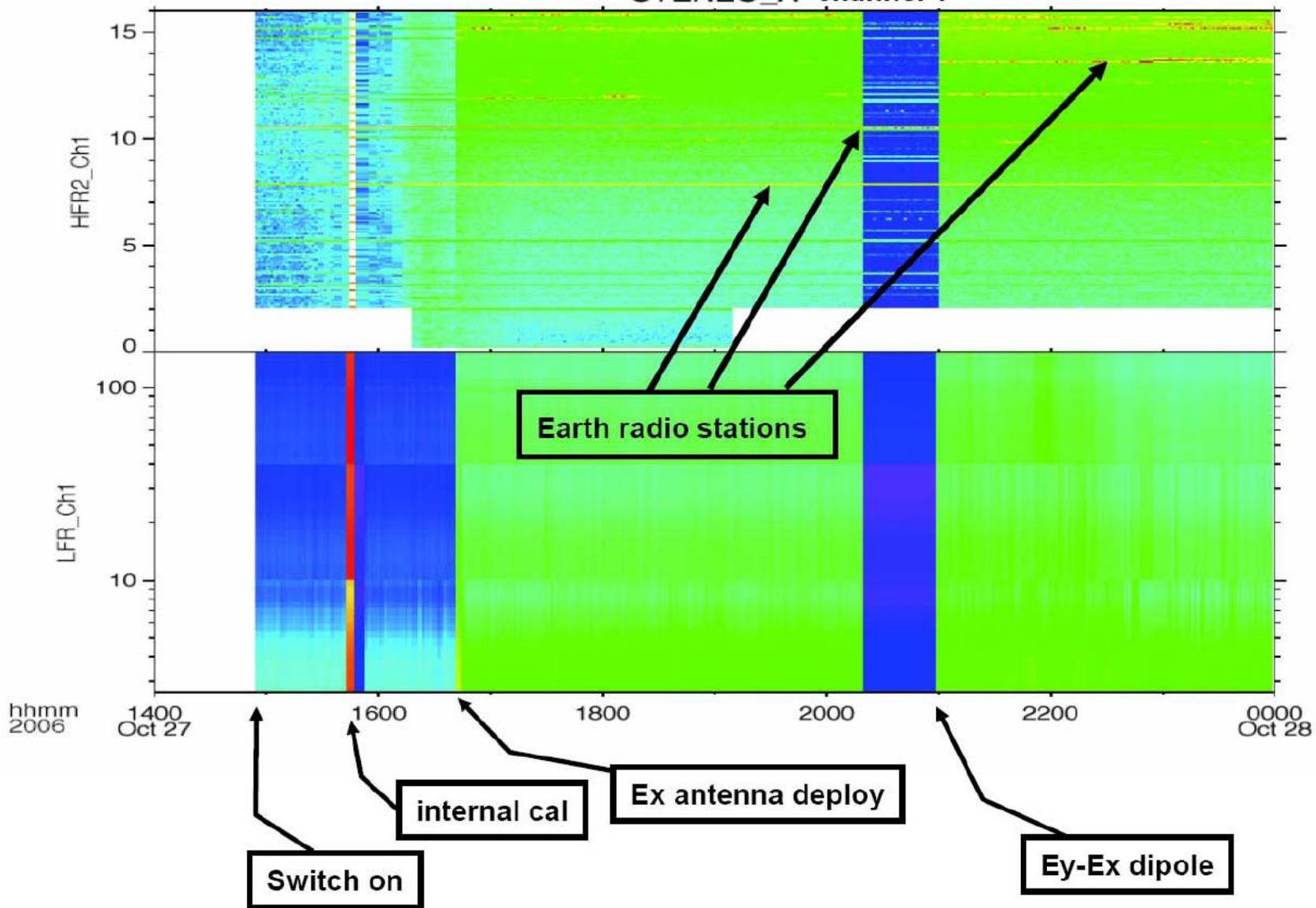
CMEs to be added here

In collaboration with M. Maksimovic, B. Cecconi, Q. N. Nguyen, Meudon Stereo/Waves team

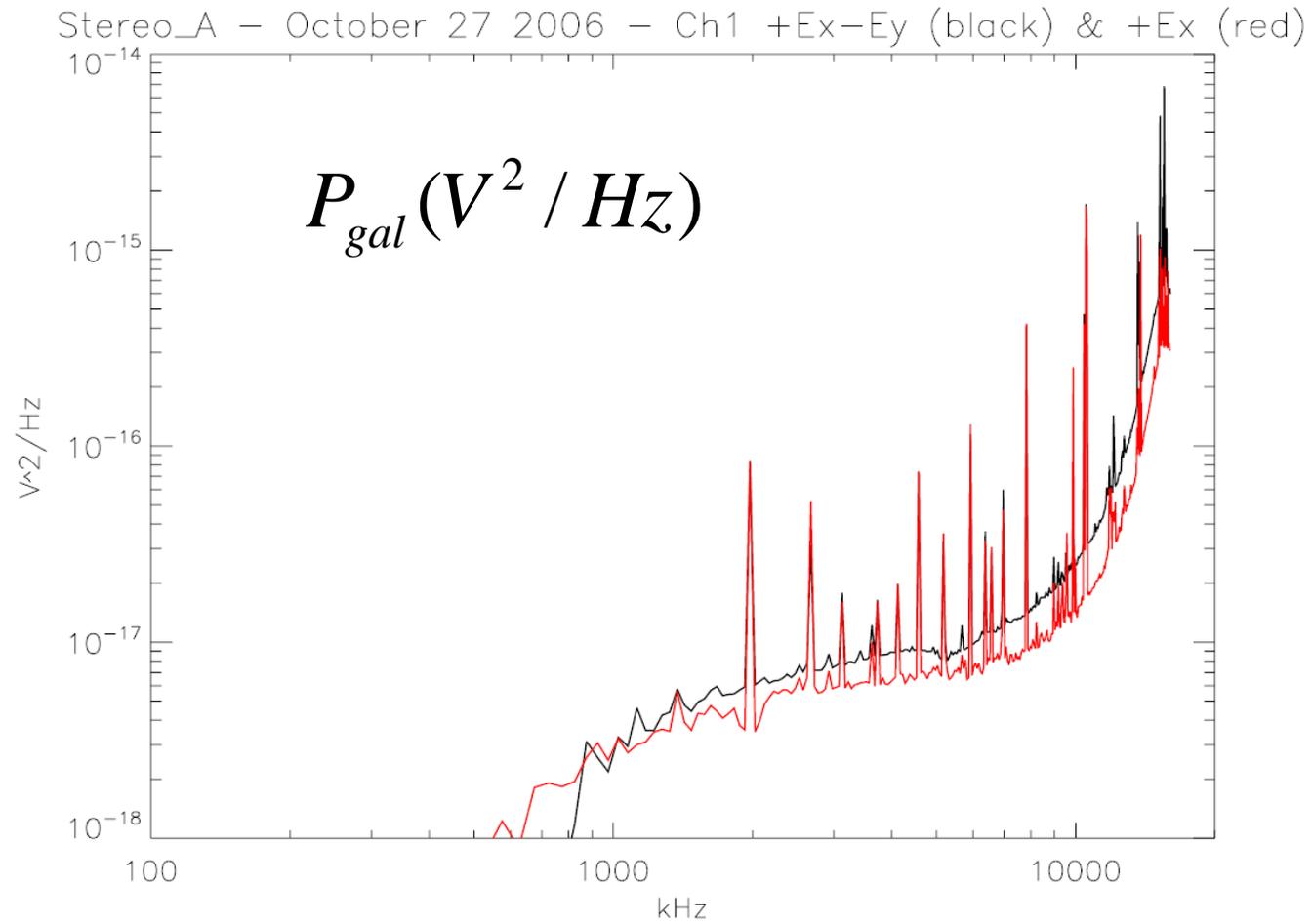
# An update on Receivers and antennas calibrations

- The receivers calibration (TM to physical units) is being finalized
- Phase corrections done (for direction finding)
- Receivers background determined, on ground and pre-deploy
- Need to calibrate the antennas gain ( $C_a$ ,  $C_b$ , length, orientation) → use of the galactic background

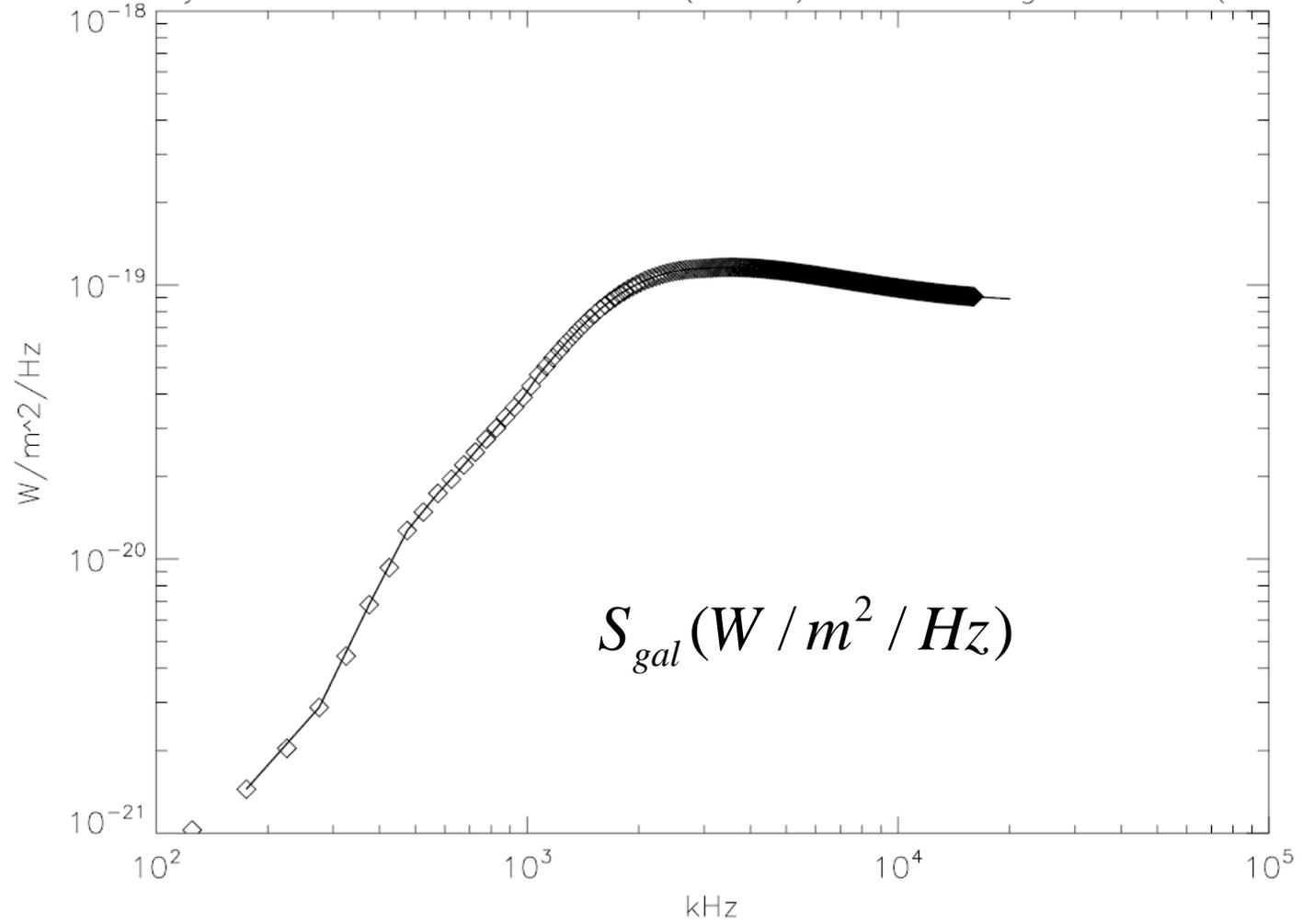
# STEREO\_A channel 1



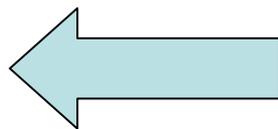
# Pre-deploy background + shot noise removed



Galaxy model from Dulk et al (2001) & Manning & Dulk (2001)

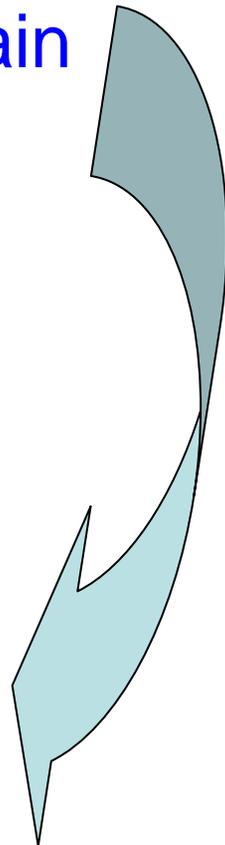
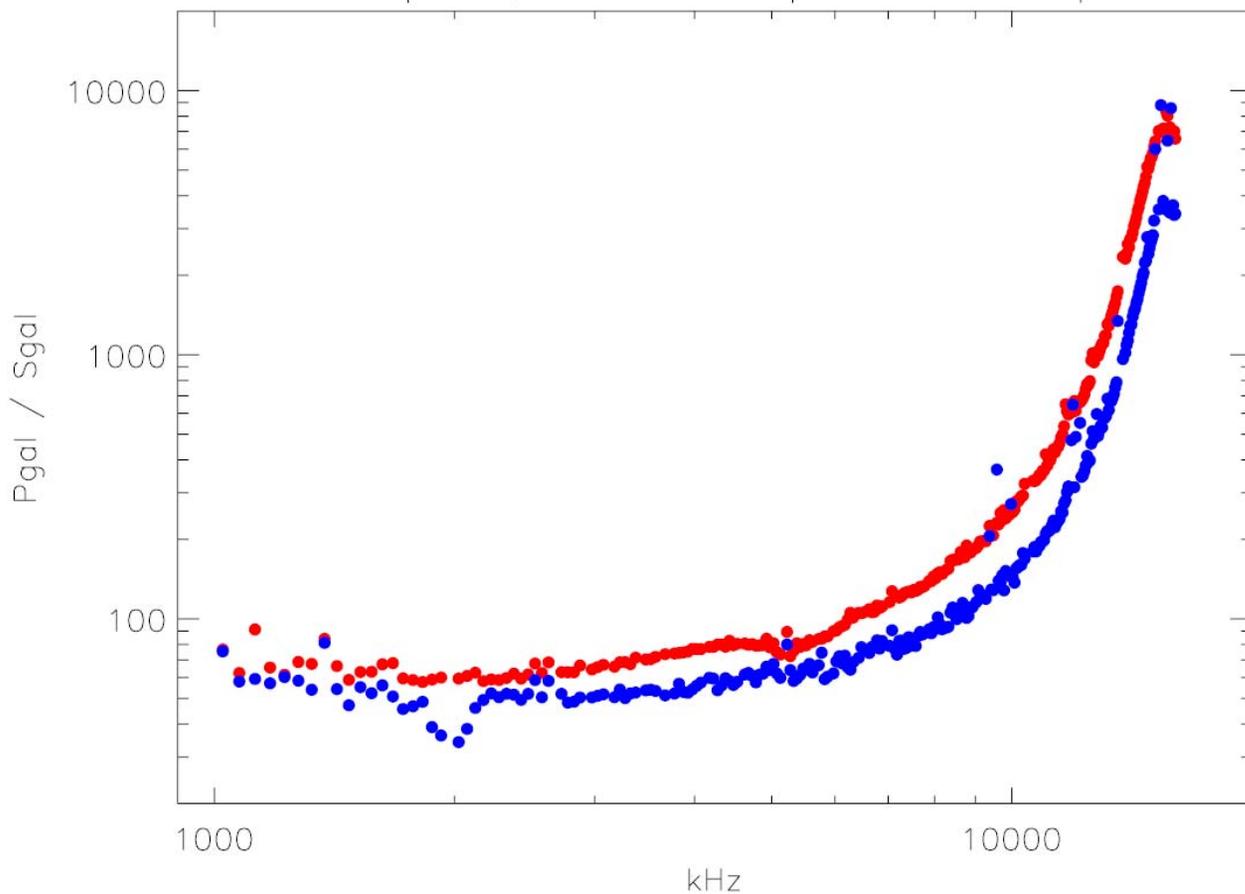


$$S_{gal}(V^2 / Hz) = \frac{P_{gal}(W / m^2 / Hz)}{Z_0 L_{eff}^2 \left( \frac{c_a}{c_a + c_b} \right)^2}$$



Antenna gain

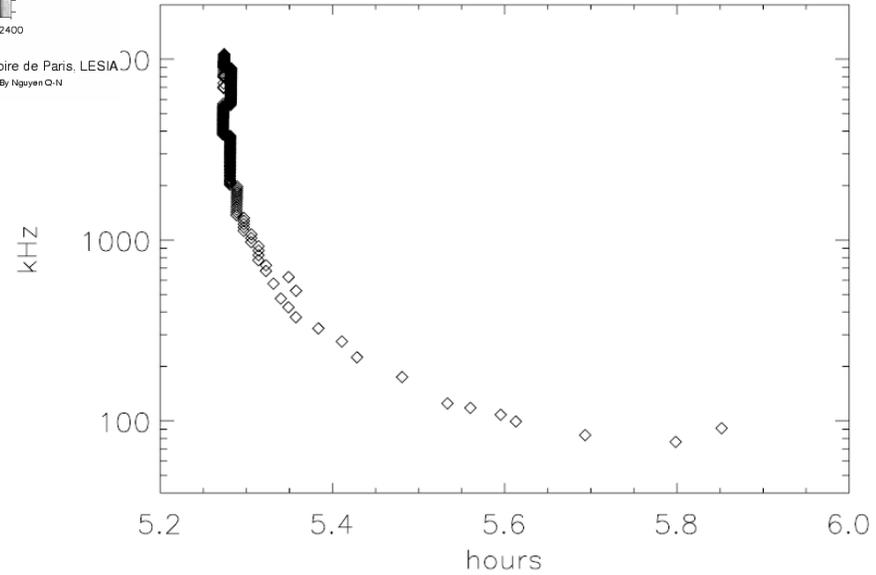
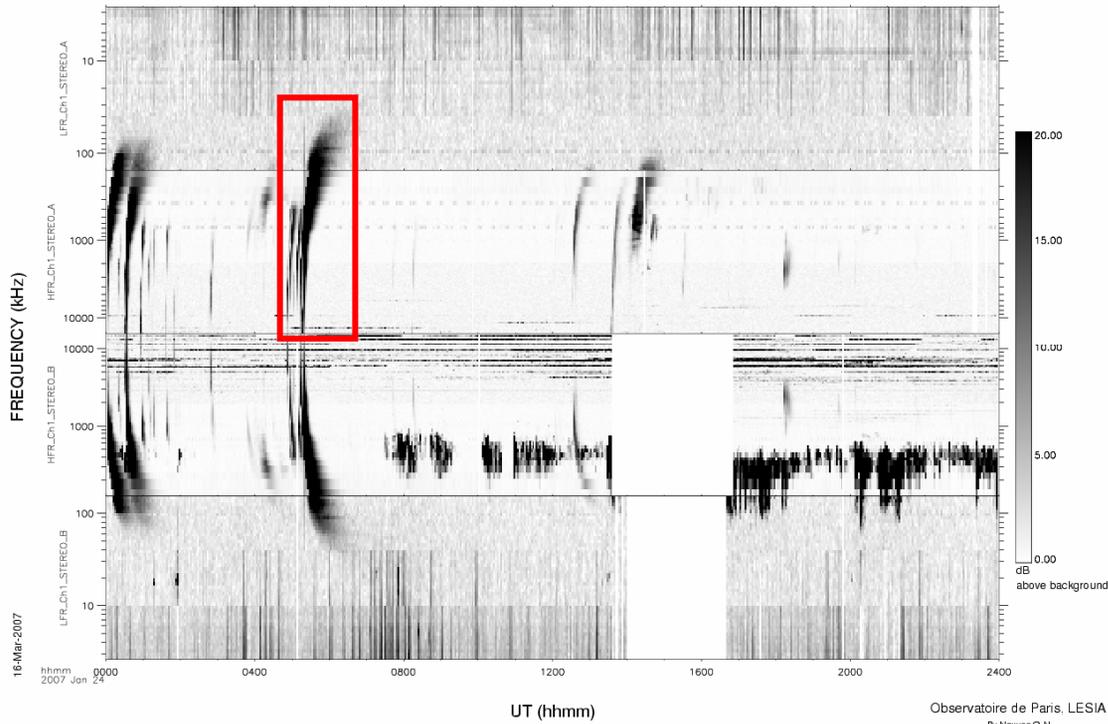
red : dipole ; blue : monopole without spikes

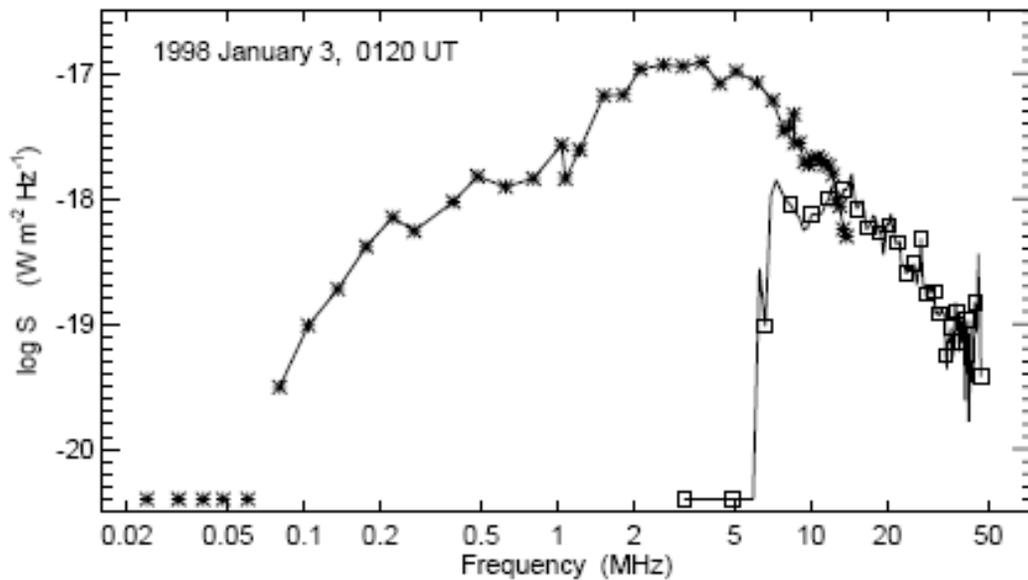
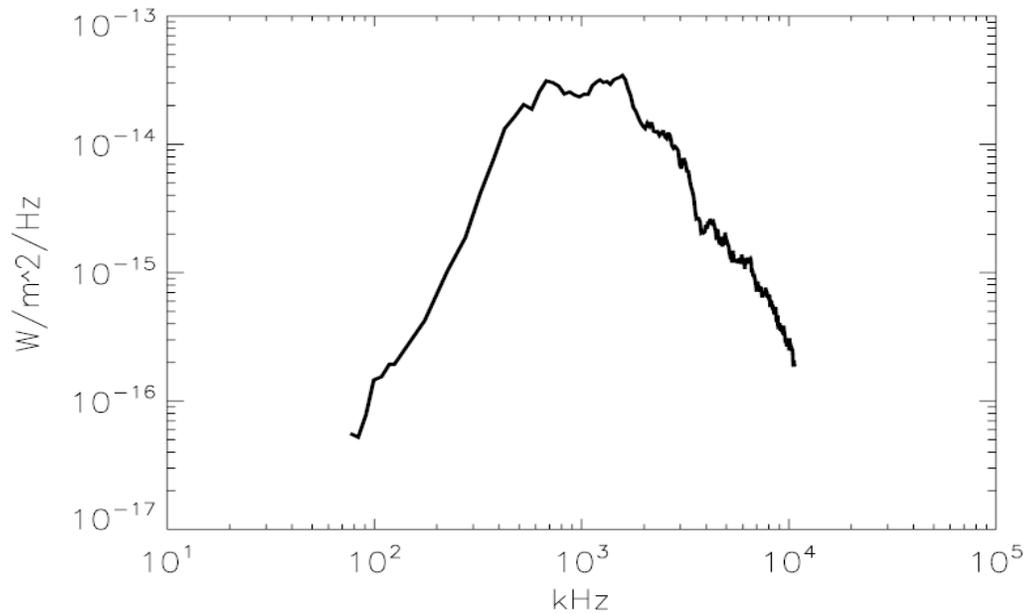




# Type III beam pattern (Xavier Bonnin)

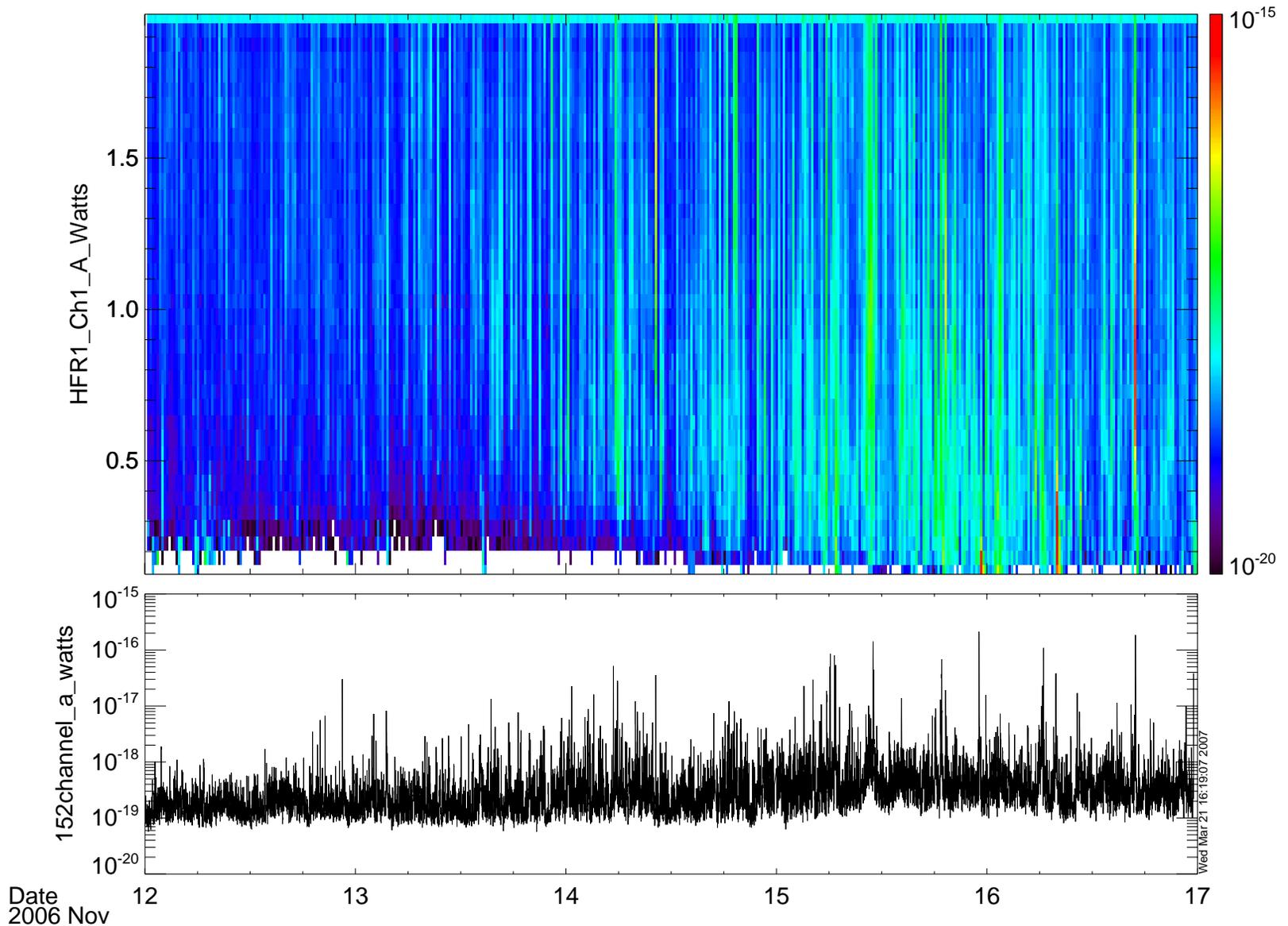
STEREO/WAVES RADIO DATA : 24-Jan-2007 DOY 024



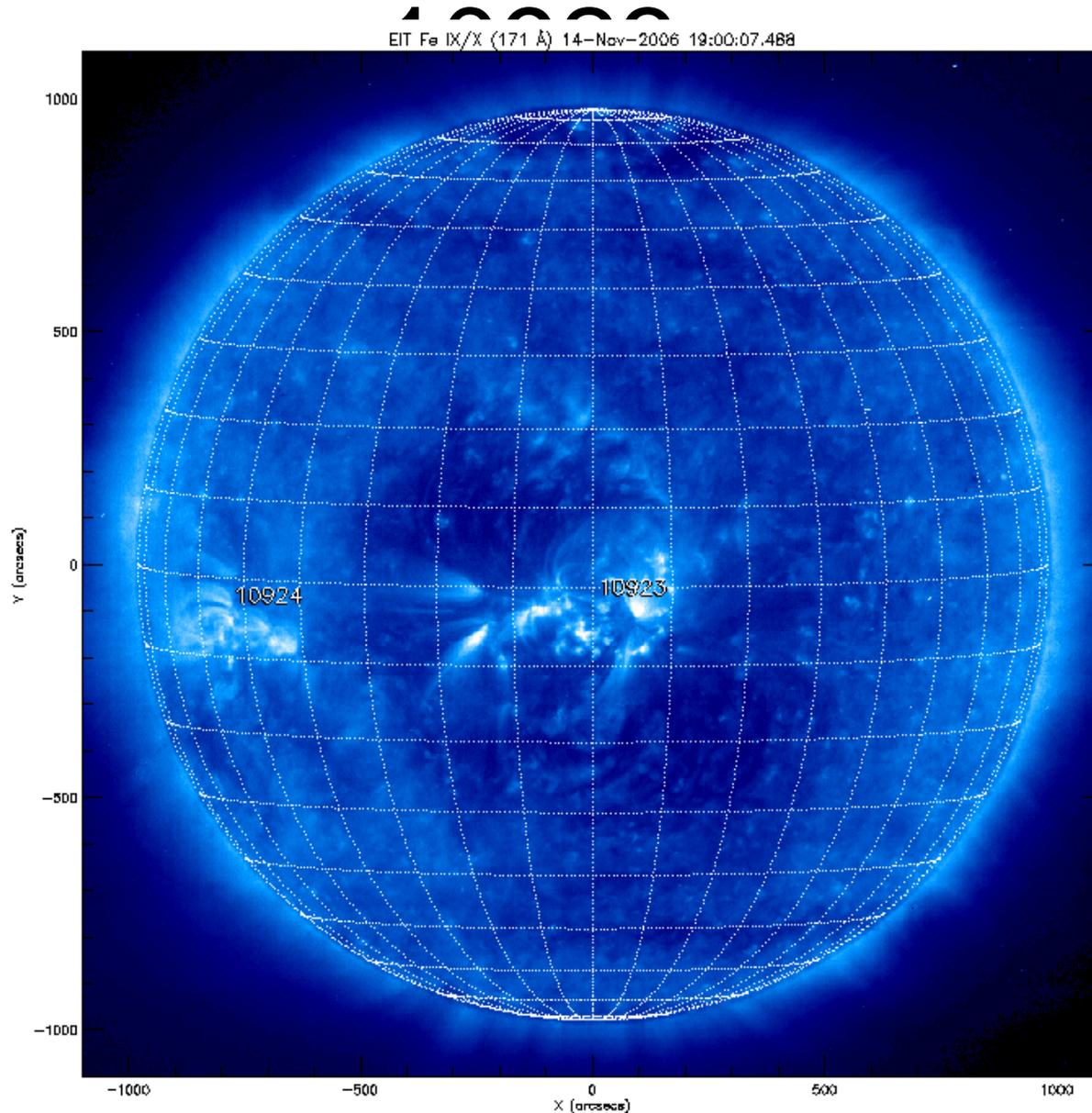


Similar to WIND  
observations  
Dulk et al., 2001

# Type III storm observed

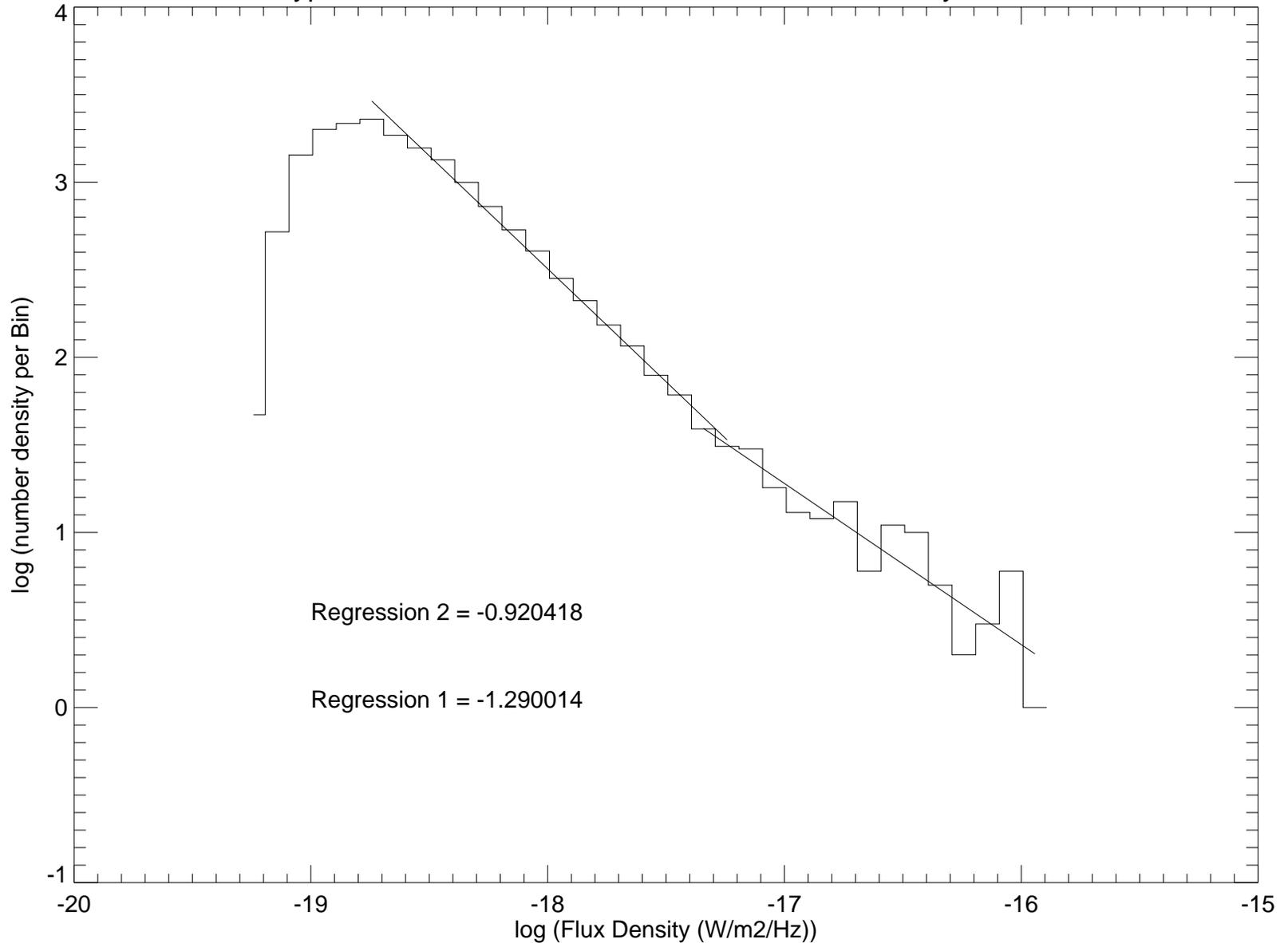


# Associated with active region

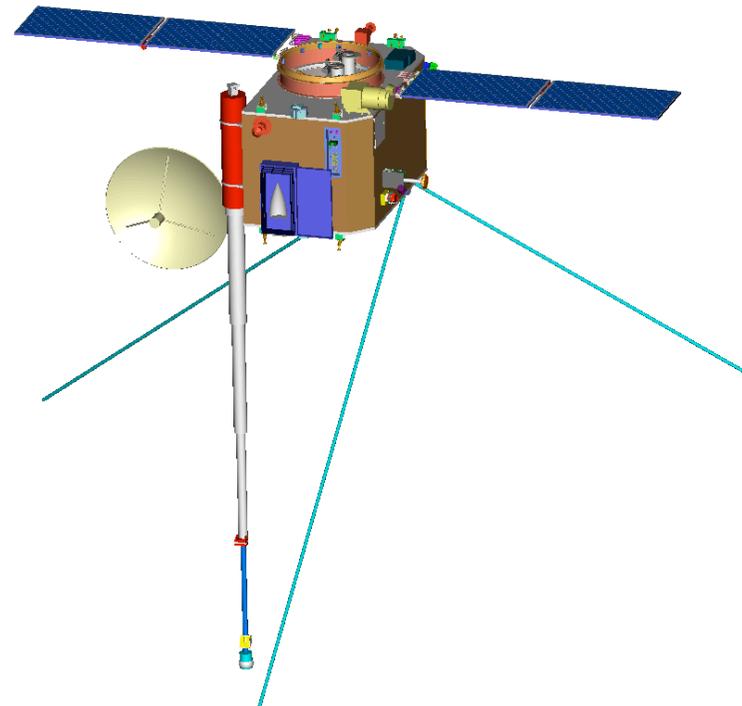
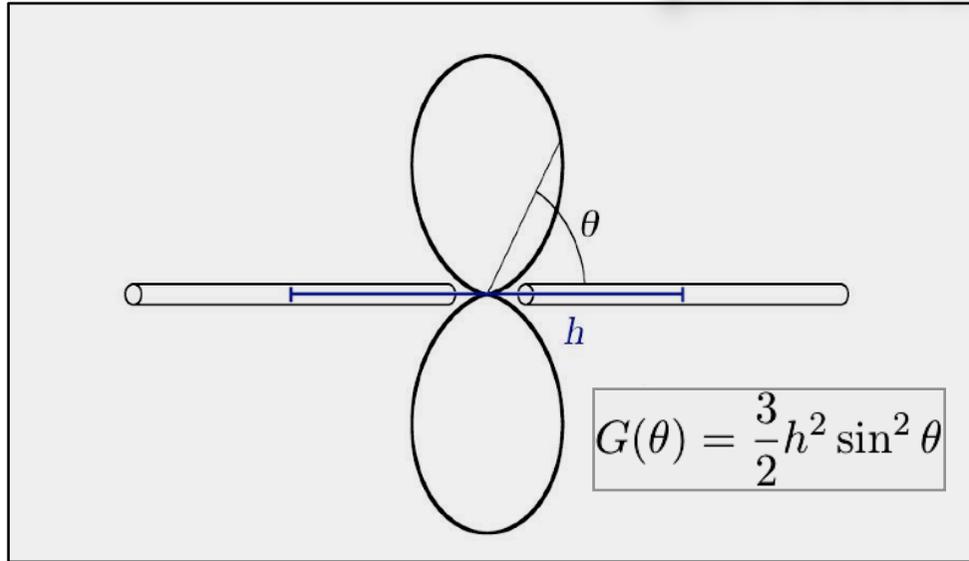


# Histogram of Type III emission

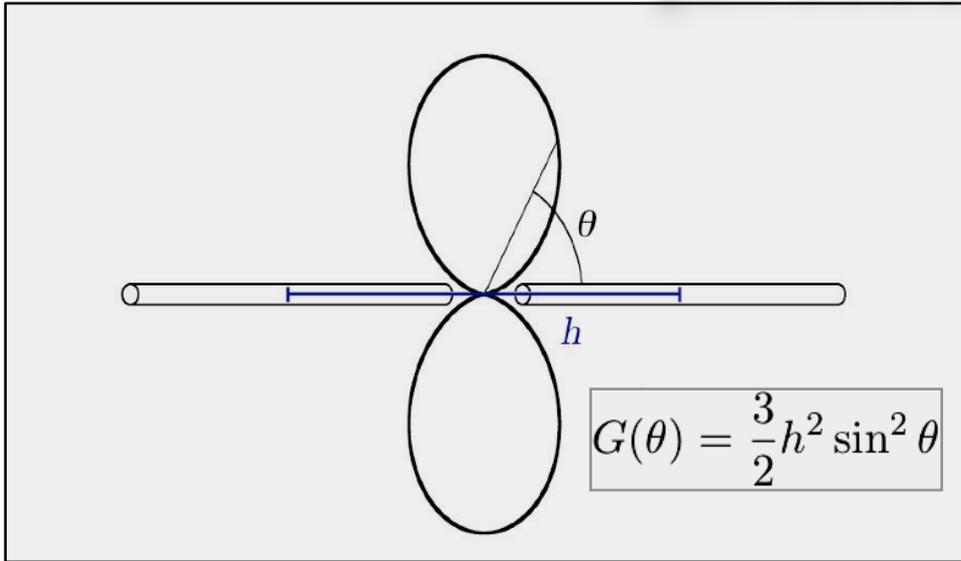
STEREO A Type III storm 2006/11/12 - 2006/11/17 inc. Intensity at 1.52500MHz



# Basics of the Goniopolarimetry (*direction-finding*)



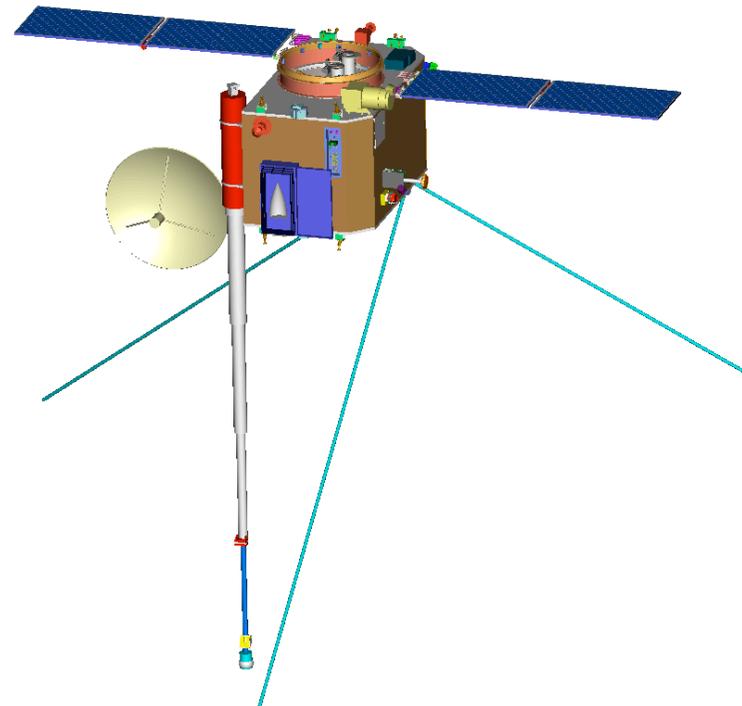
# Basics of the Goniopolarimetry (direction-finding)



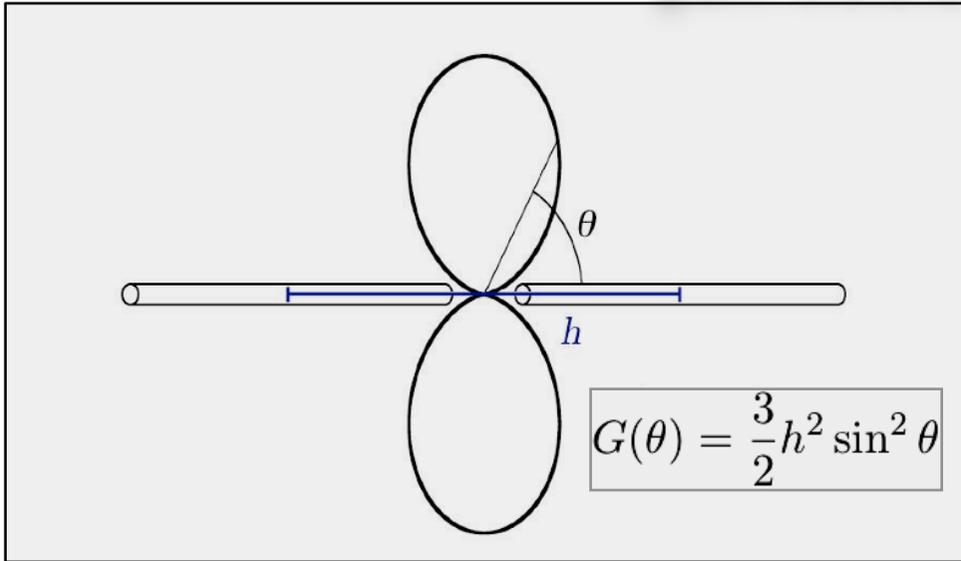
$$V_h = \int_{\mathbf{h}} \mathbf{E} \cdot d\mathbf{h}$$

- Short antenna hypothesis ( $h \ll \lambda$ )

$$V_h = \mathbf{h} \cdot \mathbf{E} \quad (\text{i.e. : } E \cdot h \cdot \cos\theta)$$



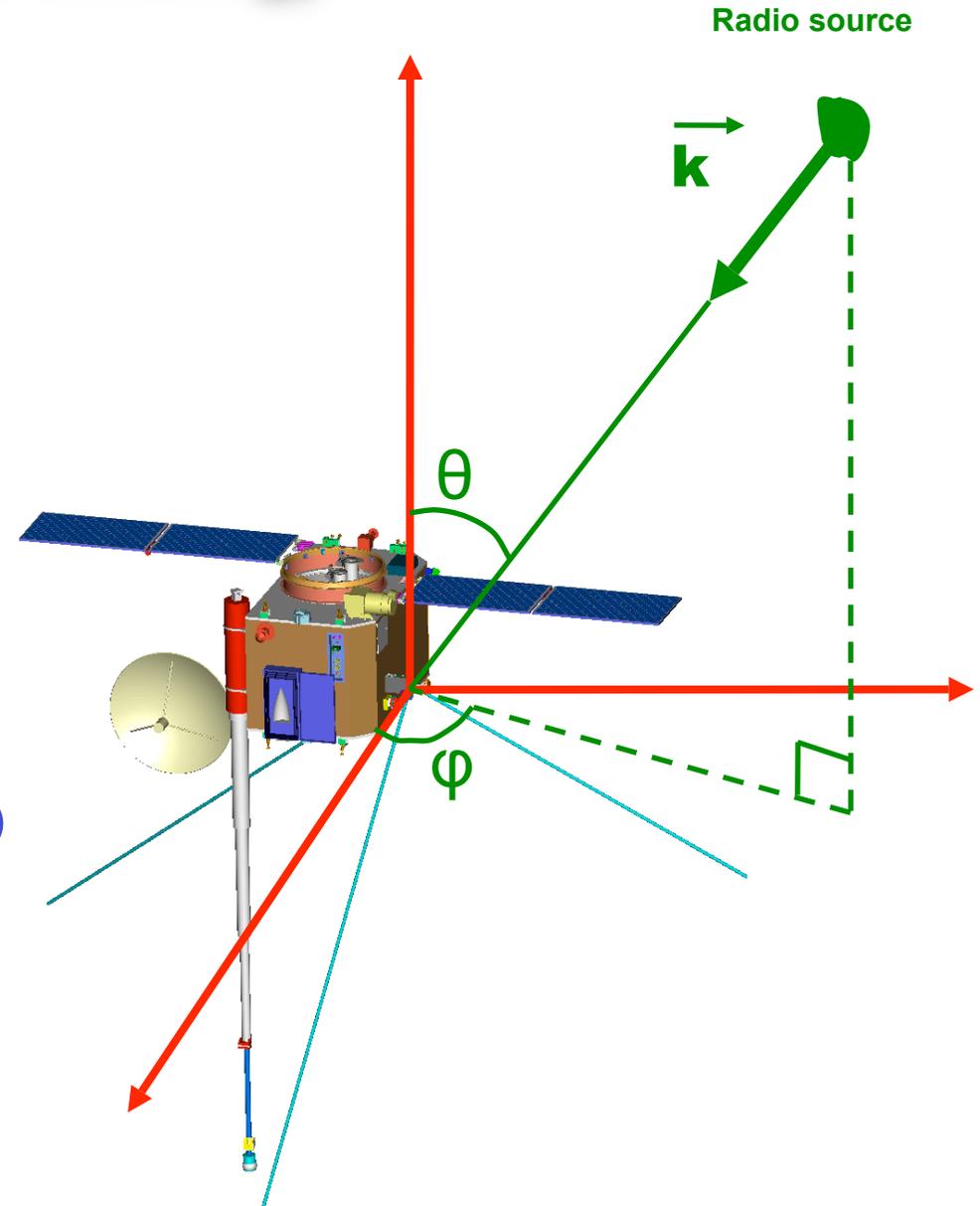
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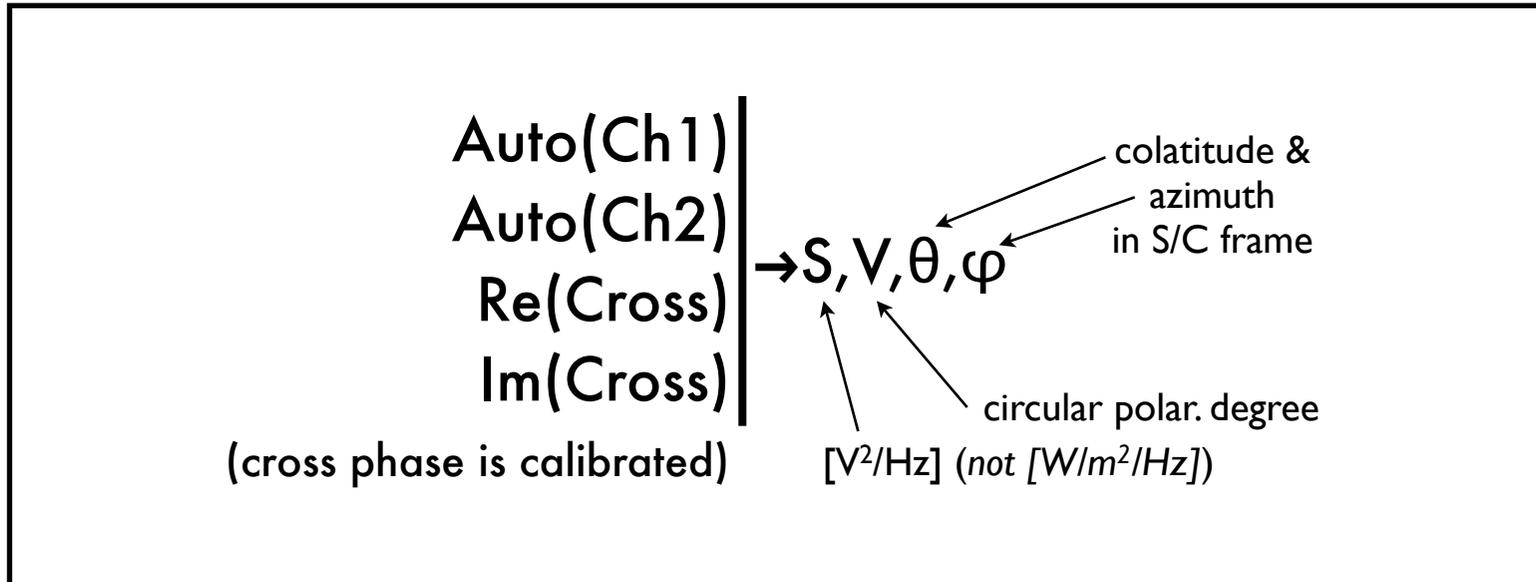


# First Goniopolarimetry with STEREO/waves

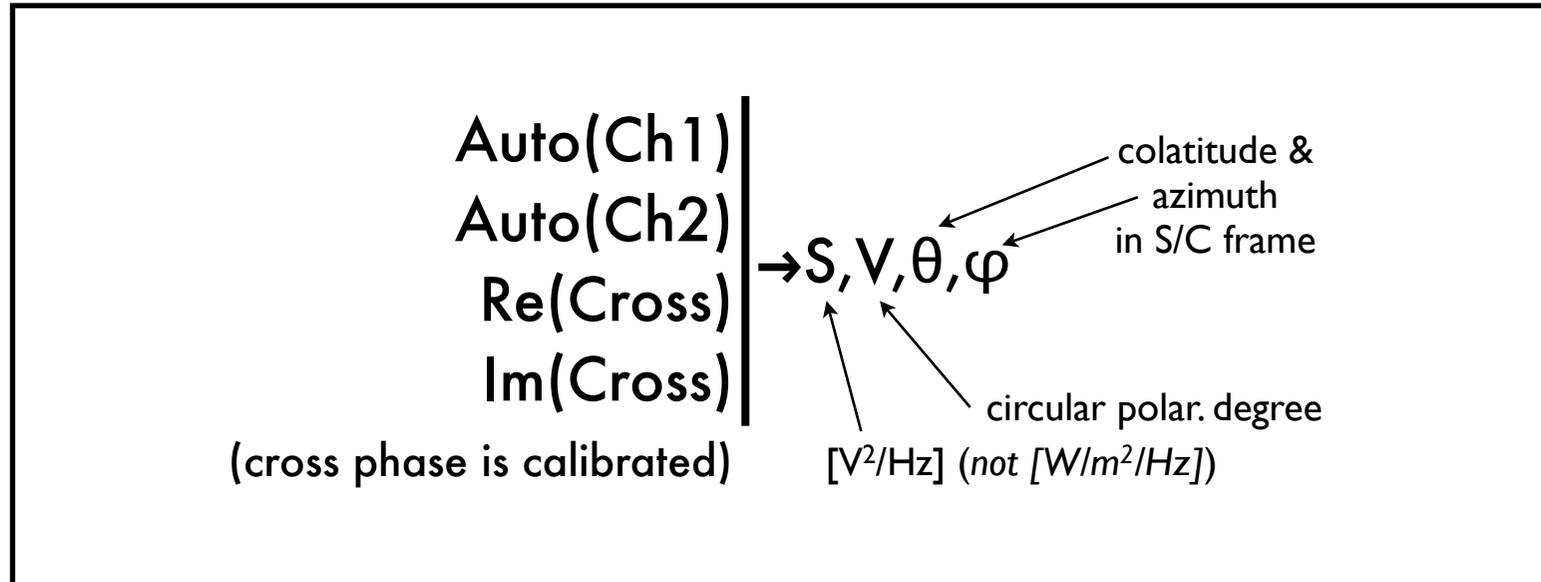
Auto(Ch1) |  
Auto(Ch2) |  
Re(Cross) | → S, V, θ, φ  
Im(Cross) |

(cross phase is calibrated)

# First Goniopolarimetry with STEREO/waves

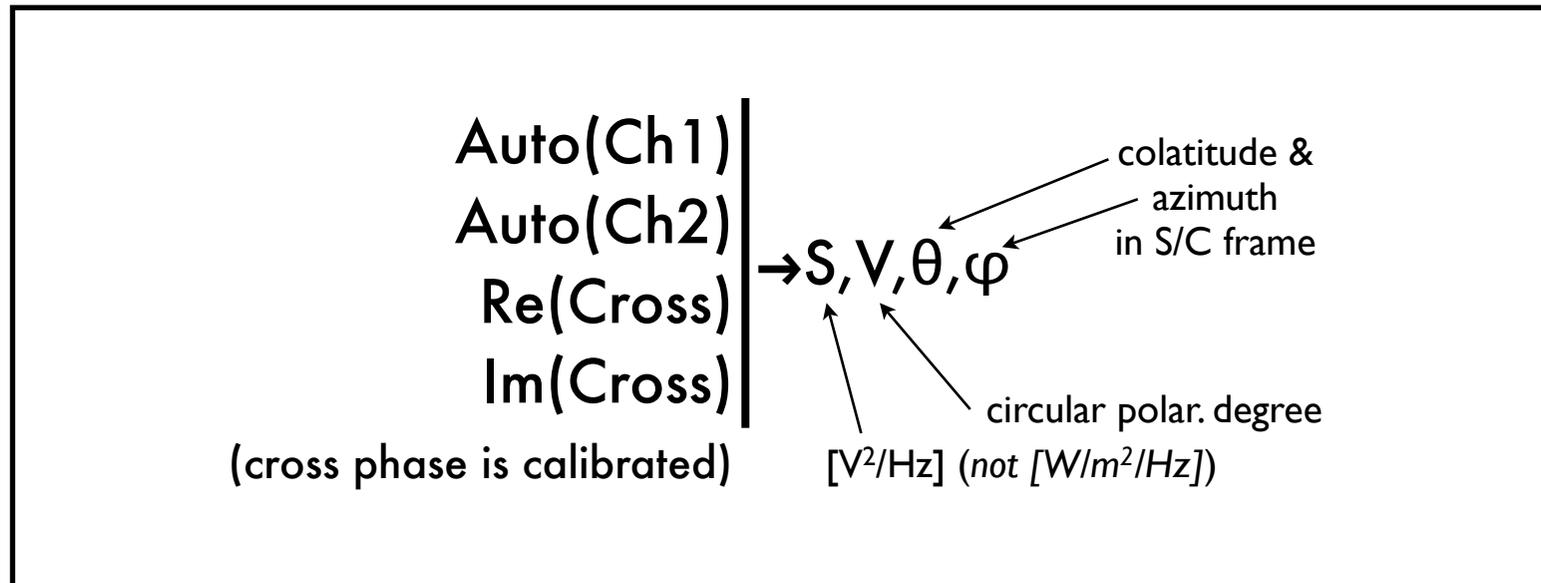


# First Goniopolarimetry with STEREO/waves



Background level picked by hand  
(will be automatic in routine data analysis)

# First Goniopolarimetry with STEREO/waves



Background level picked by hand  
(will be automatic in routine data analysis)

Antenna parameters (effective length/directions)  
from austrian team, computed through simulations  
(Oswald et al., submitted to ASR)

# Antenna calibration : effective lengths/directions

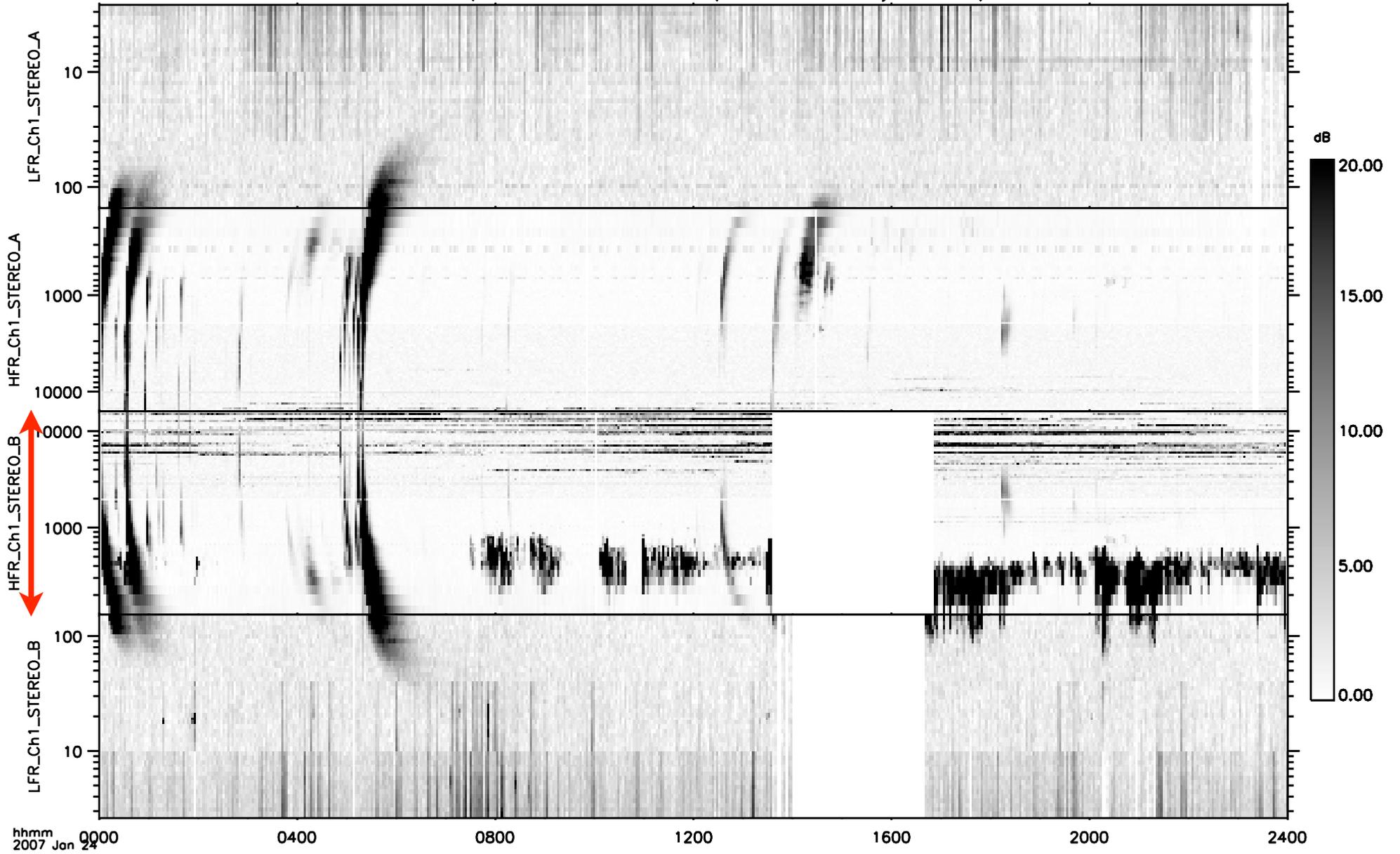
Table 2. STEREO A, loaded feeds at 300kHz determined by use of ASAP, CONCEPT II and rheometry

		ASAP	CONCEPT	rheo	physical
Ex	l/m	1.19	1.17	1.16	6.00
	$\zeta/^\circ$	120.3	119.3	122.3	125.3
	$\xi/^\circ$	-135.3	-134.8	-135.9	-120.0
Ey	l/m	1.43	1.42	1.46	6.00
	$\zeta/^\circ$	114.7	113.9	115.7	125.3
	$\xi/^\circ$	127.5	127.3	126.9	120.0
Ez	l/m	0.96	0.96	0.98	6.00
	$\zeta/^\circ$	124.9	123.9	126.8	125.3
	$\xi/^\circ$	15.4	15.0	17.0	0.0

[Oswald et al. submitted to Adv. Space Res., 2007]

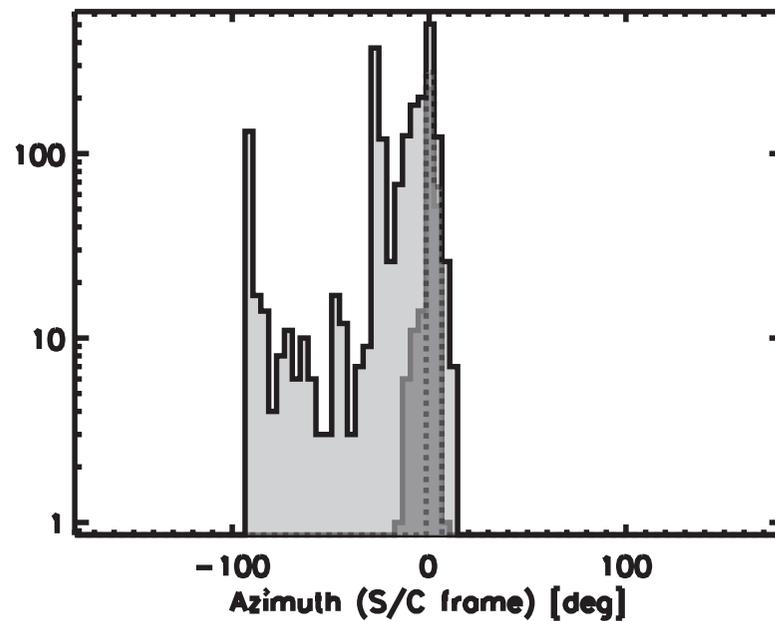
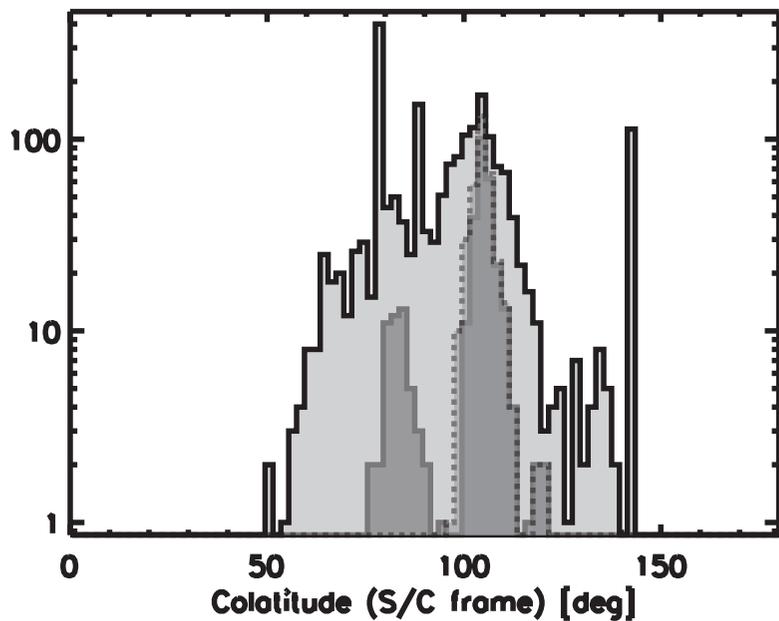
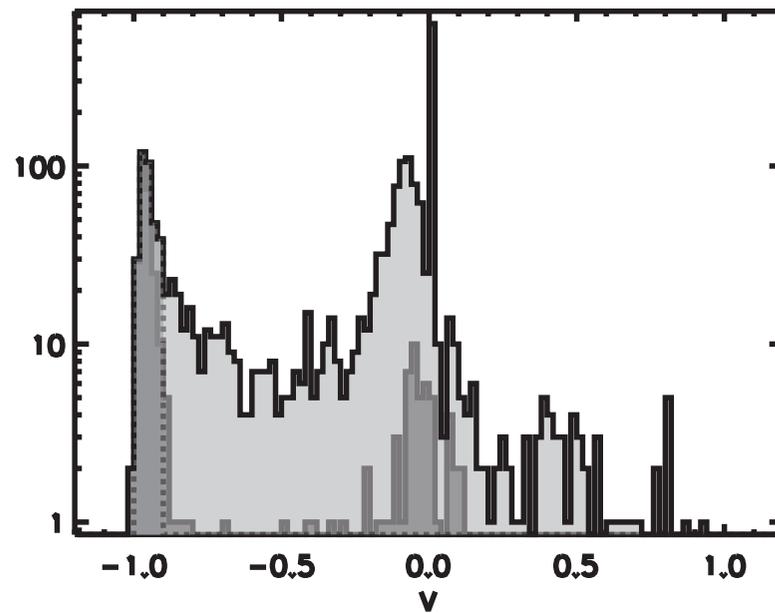
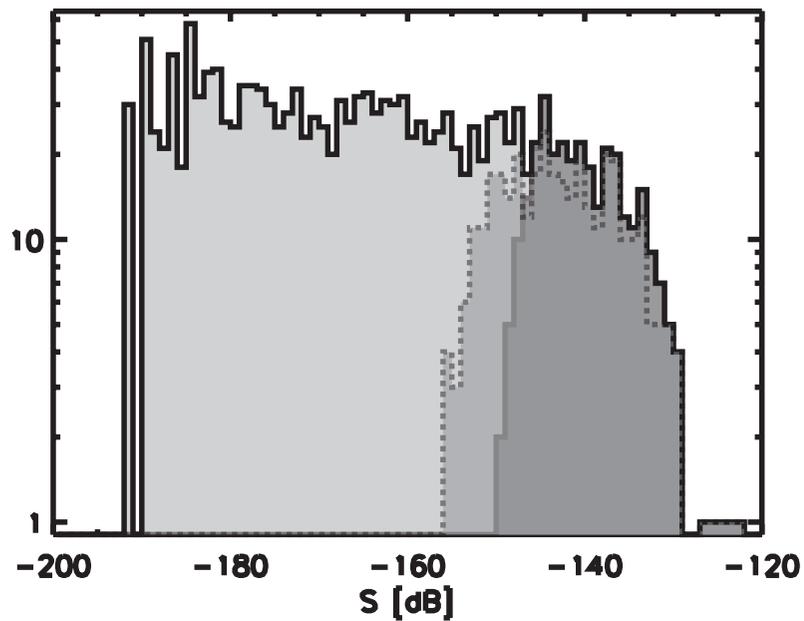
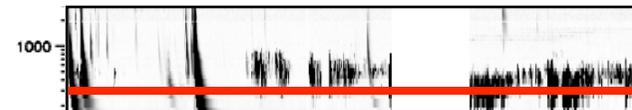
# Jan. 24th 2007

STEREO/Waves SUMMARY PLOT (Paris Observatory - LESIA)



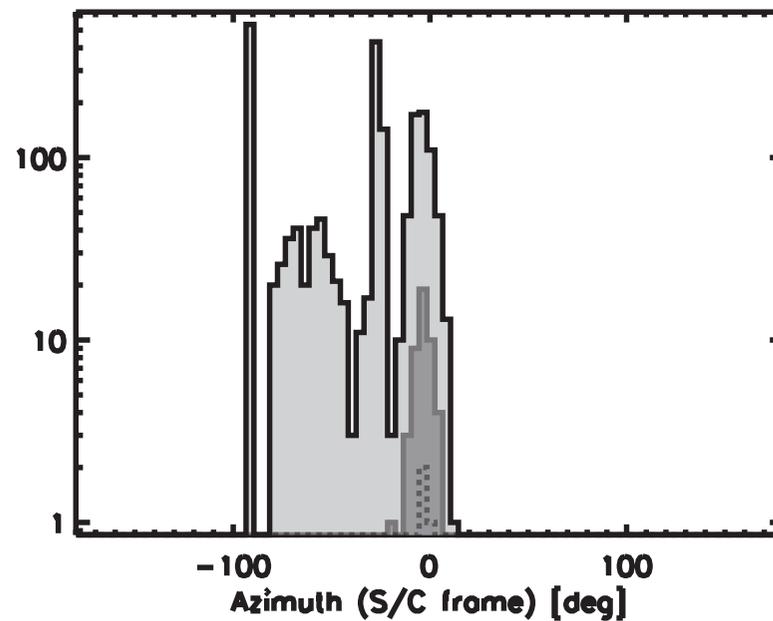
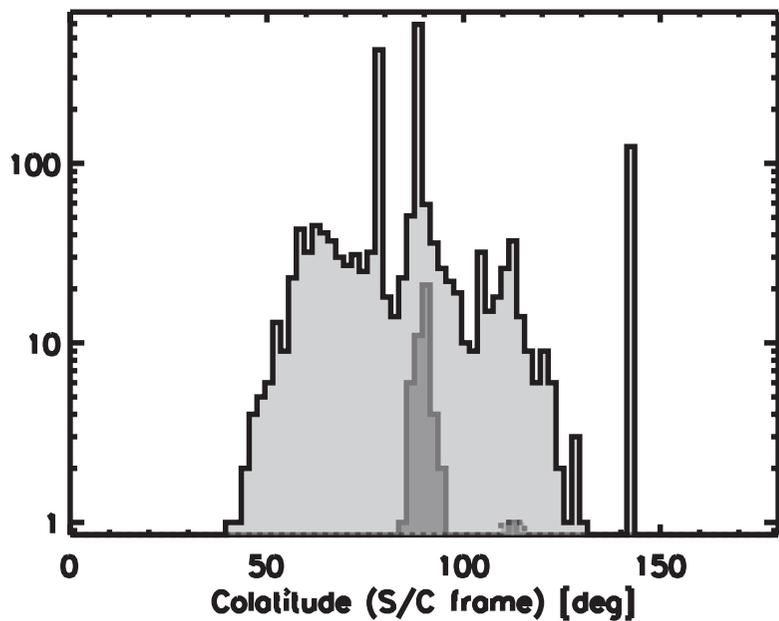
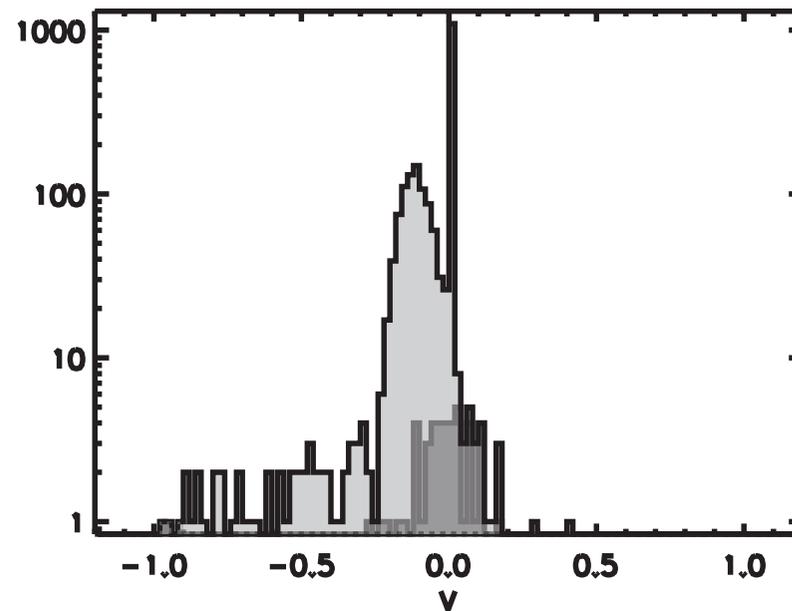
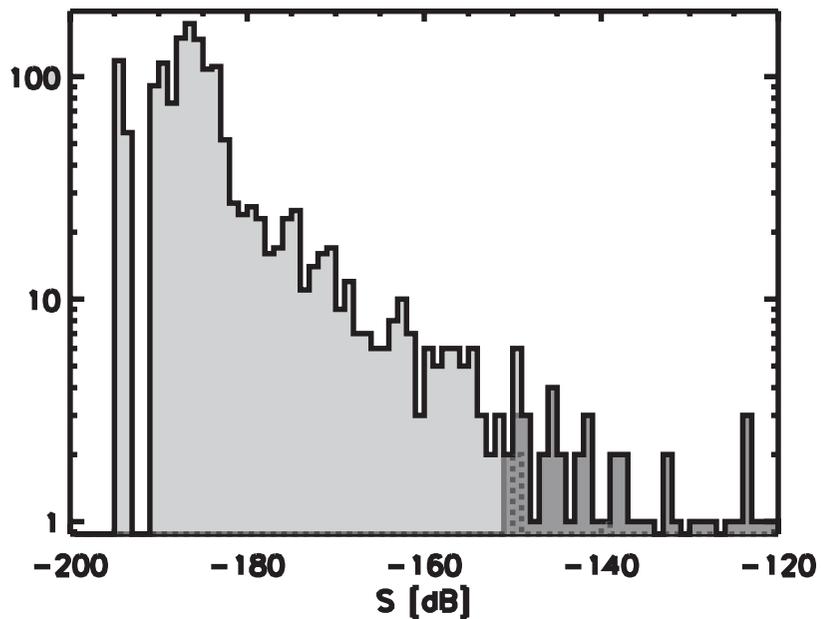
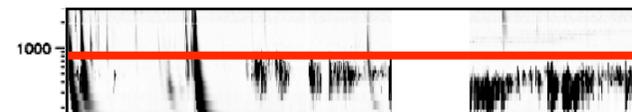


# 275 kHz



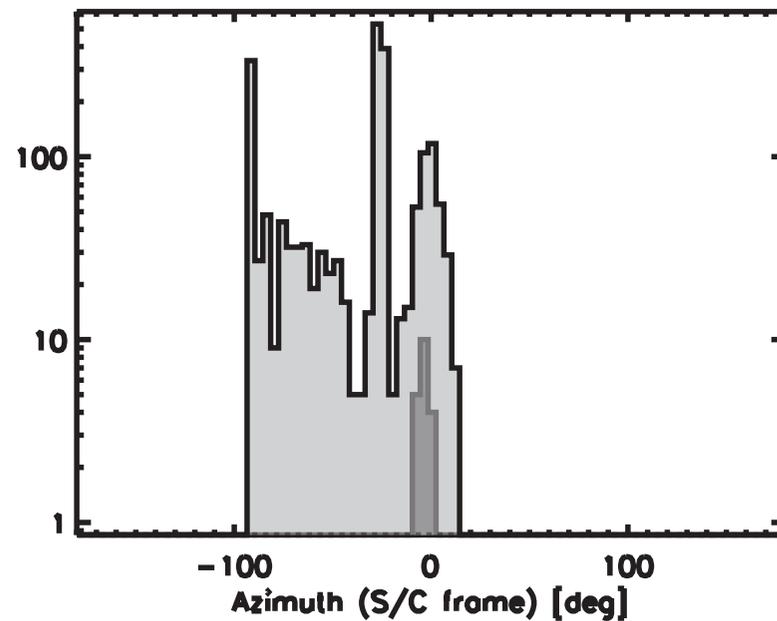
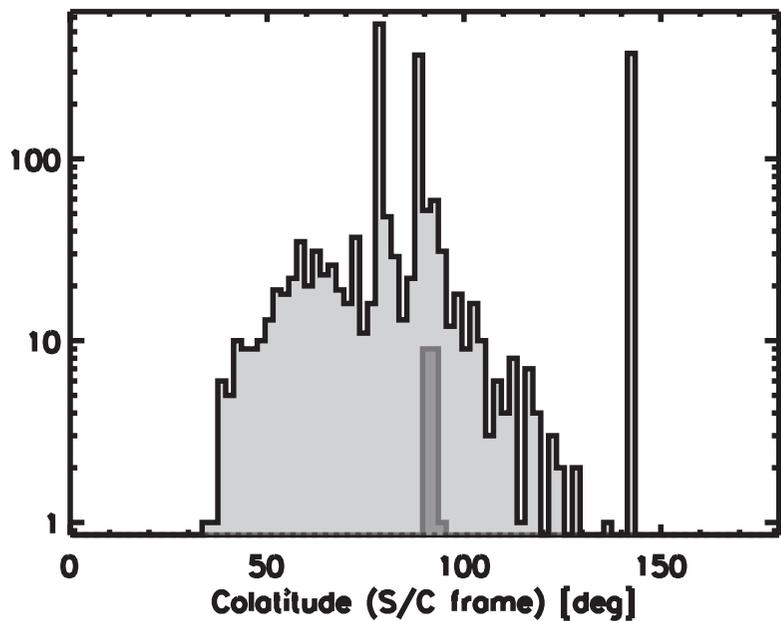
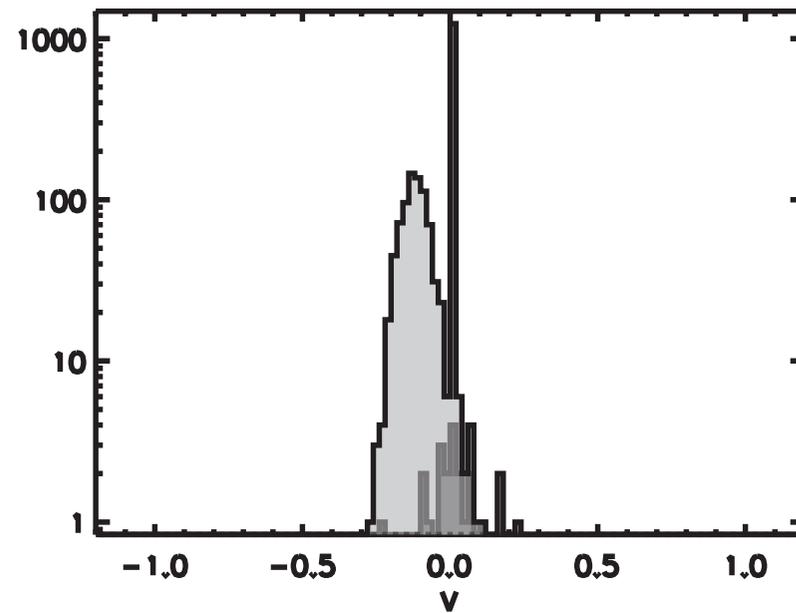
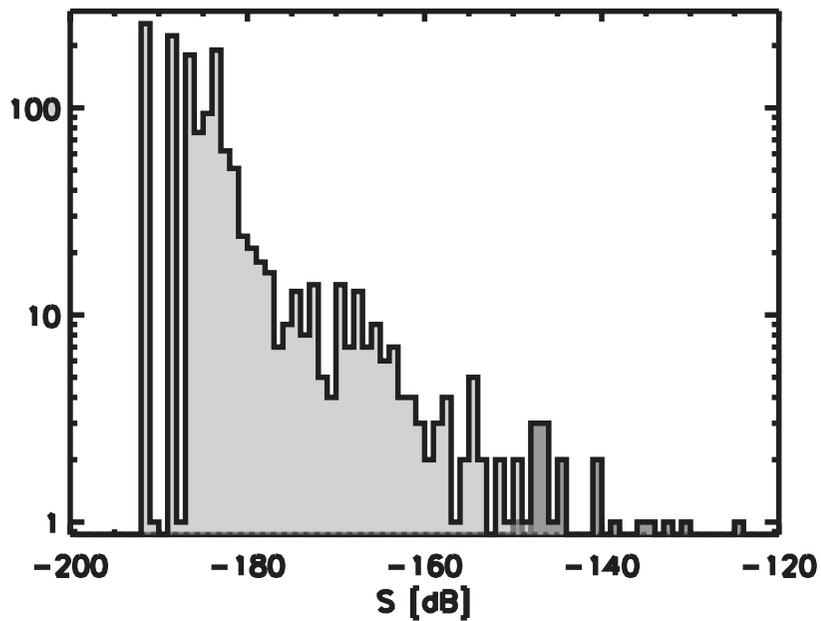
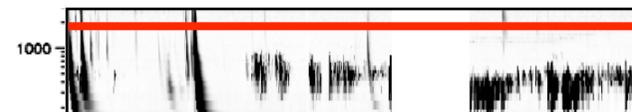


# 775 kHz

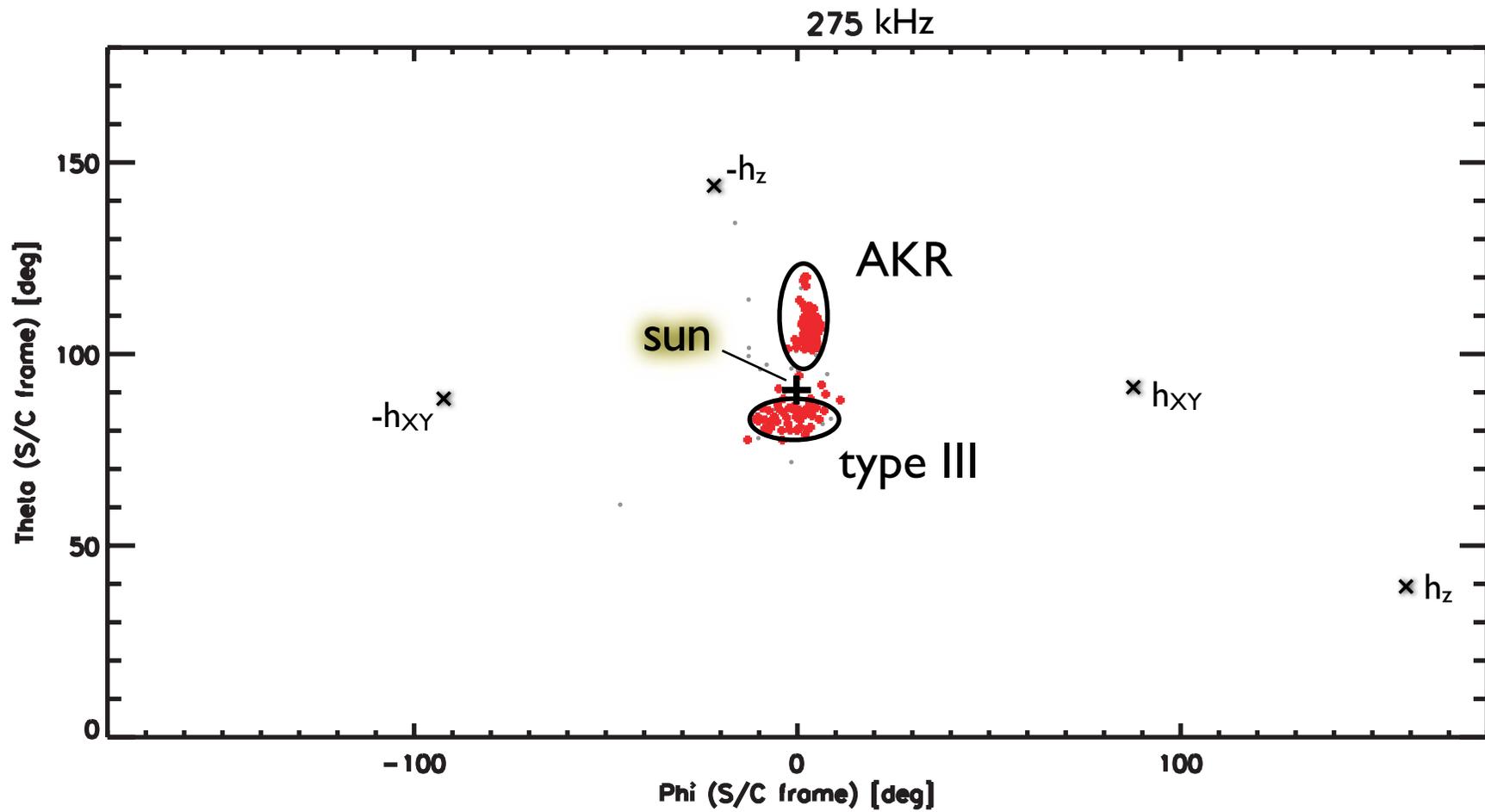
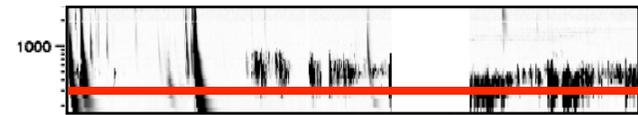




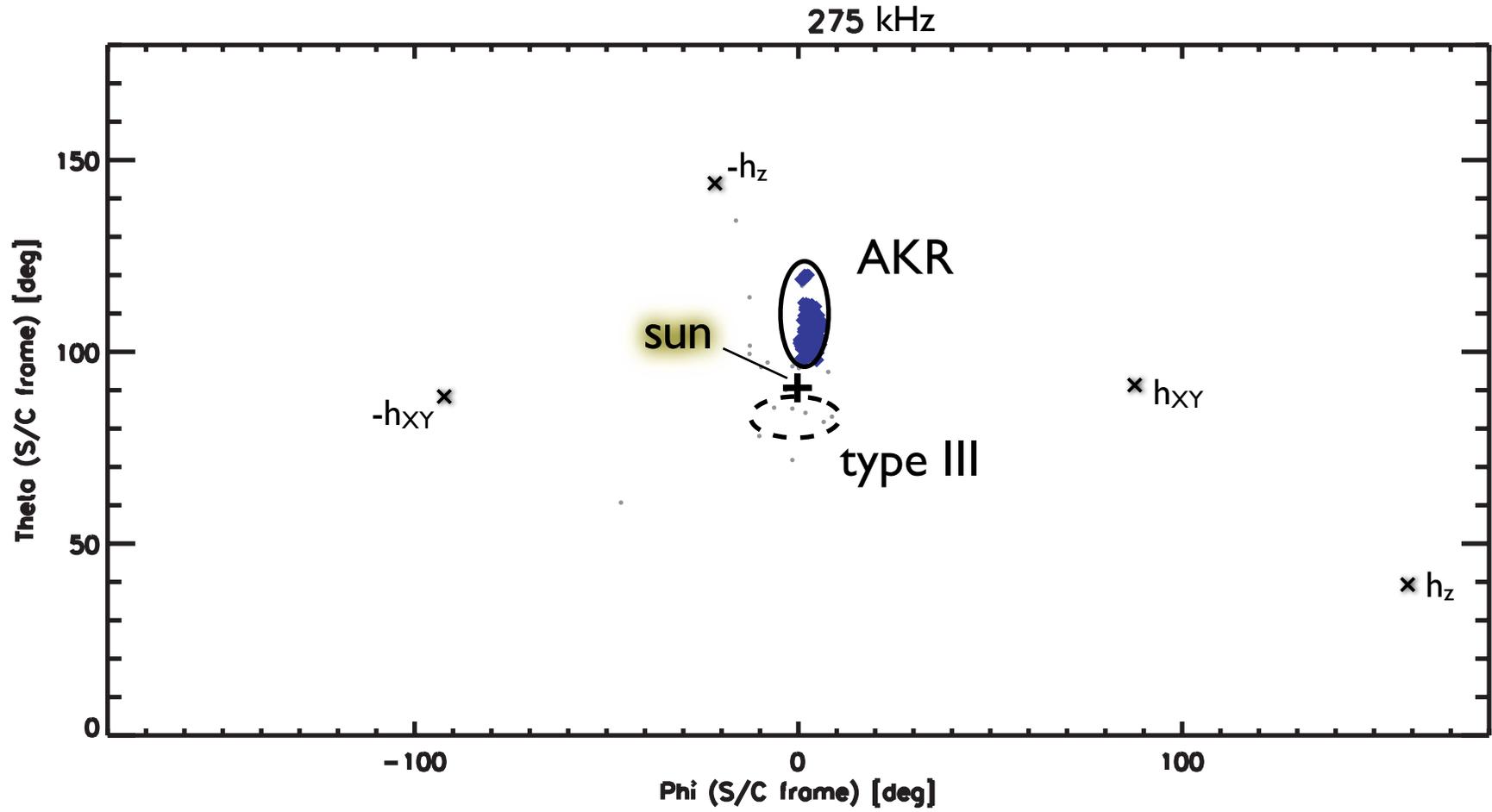
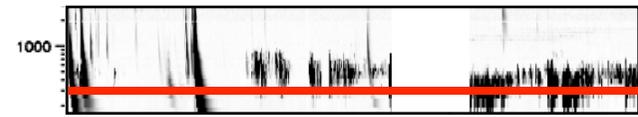
# 1625 kHz



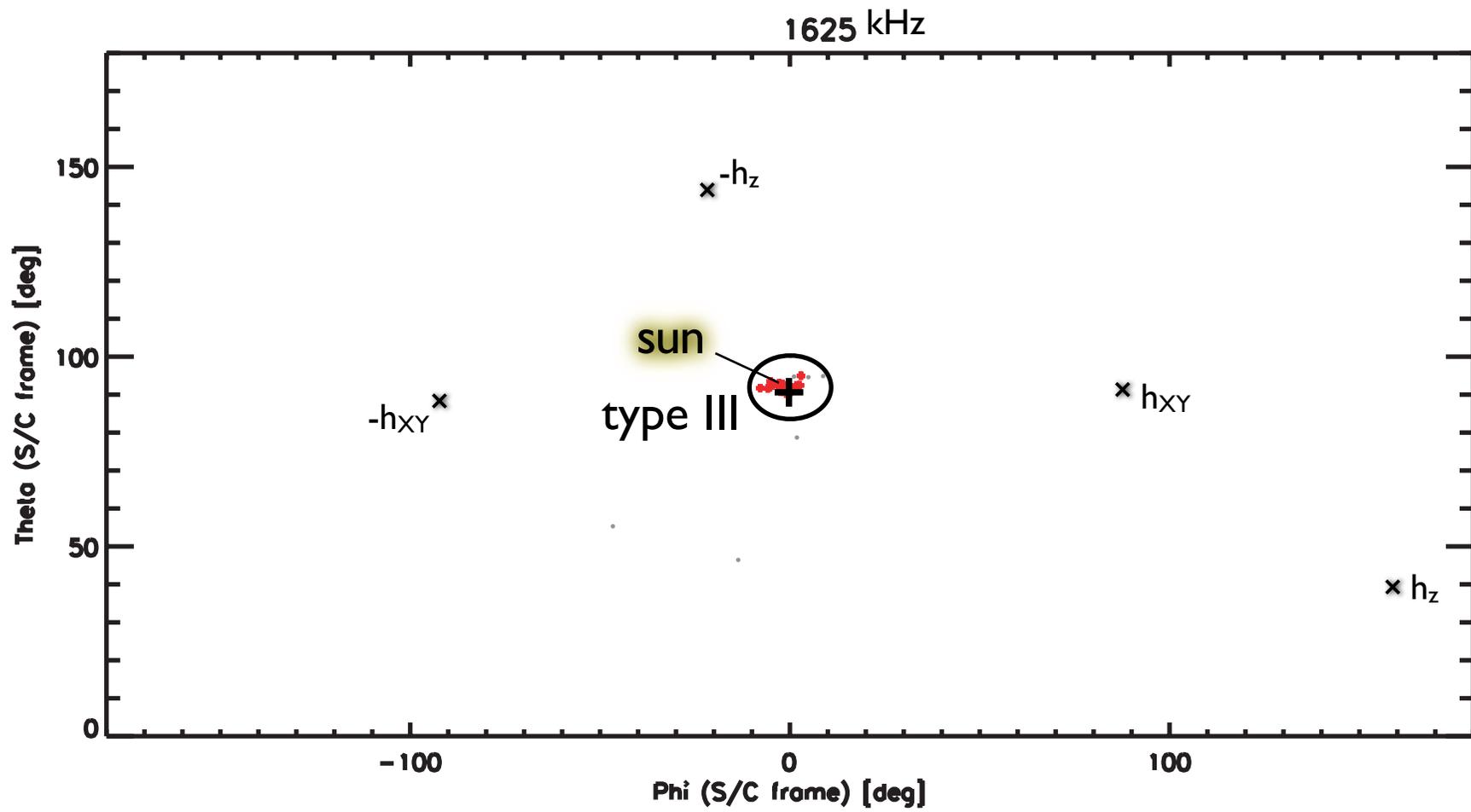
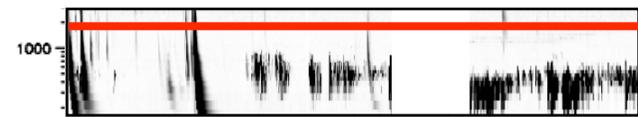
■ SNR > 30 dB



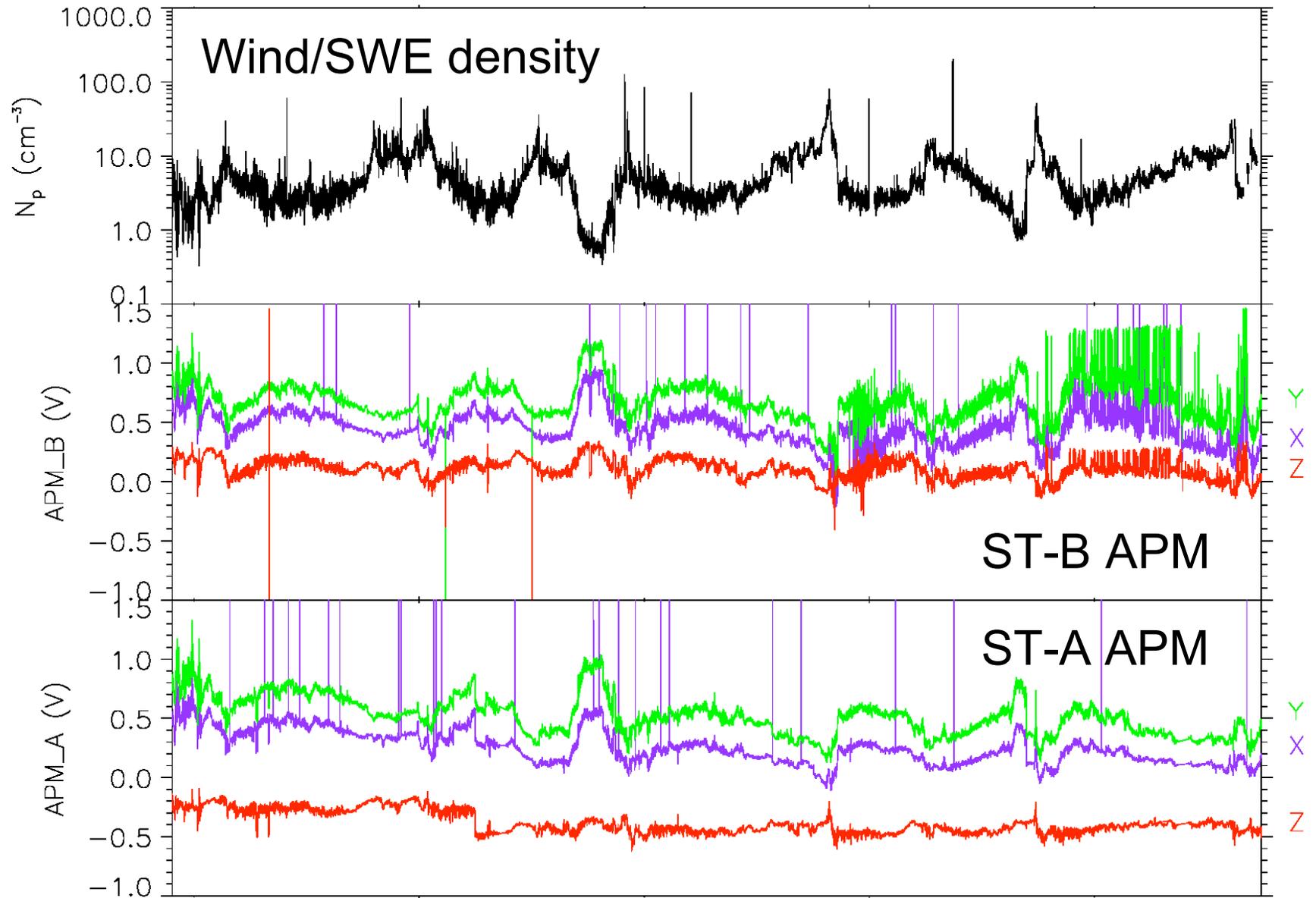
■  $-1.0 < V < -0.9$



■ SNR > 30 dB



STEREO

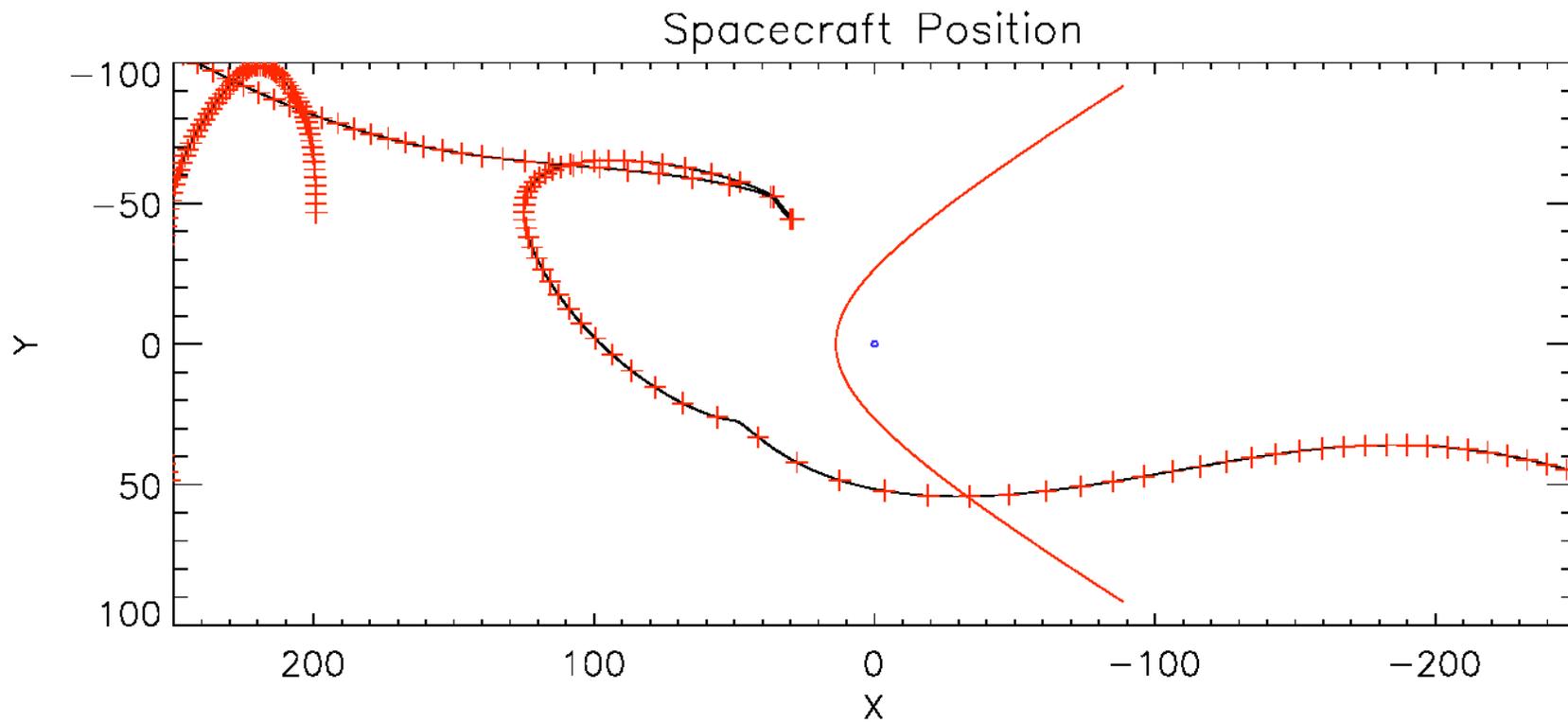


Month  
2007

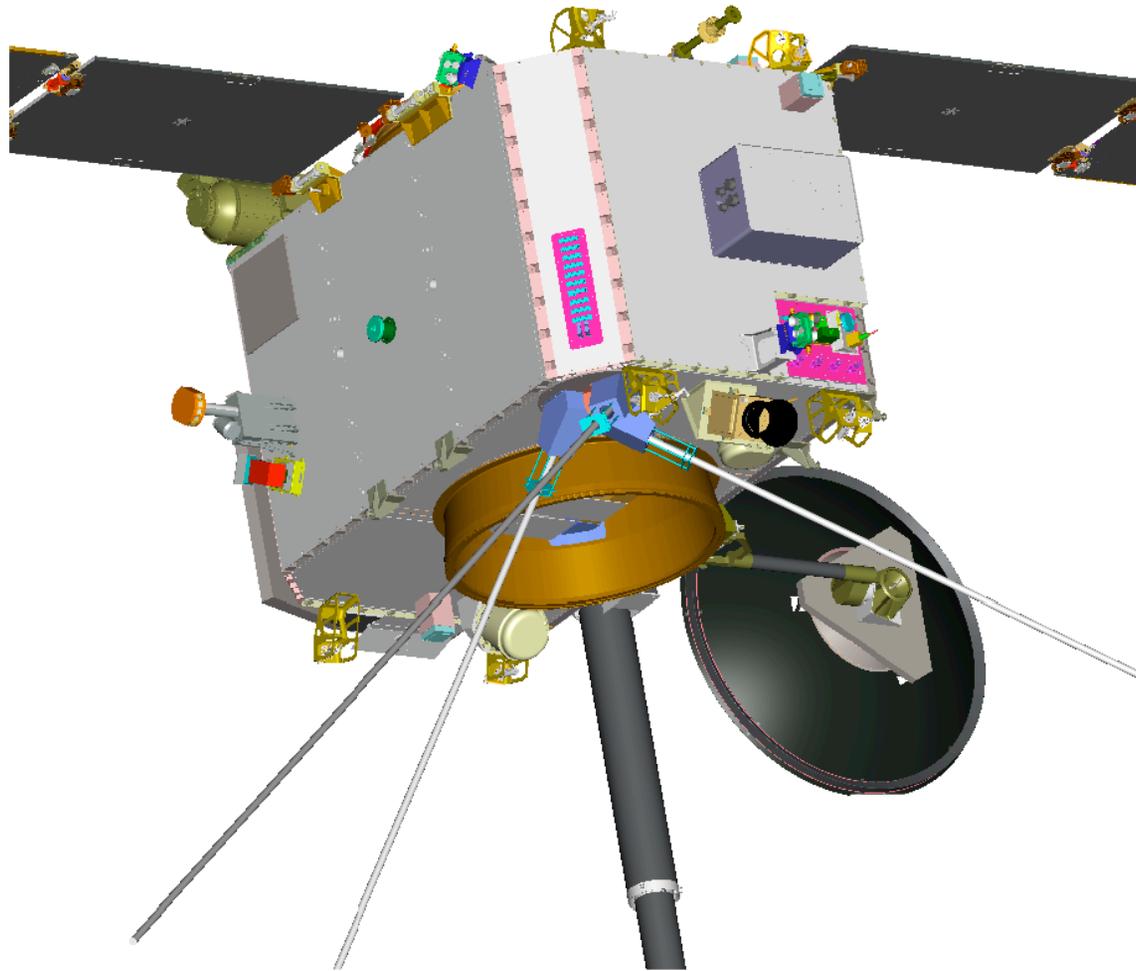
Jan

Feb

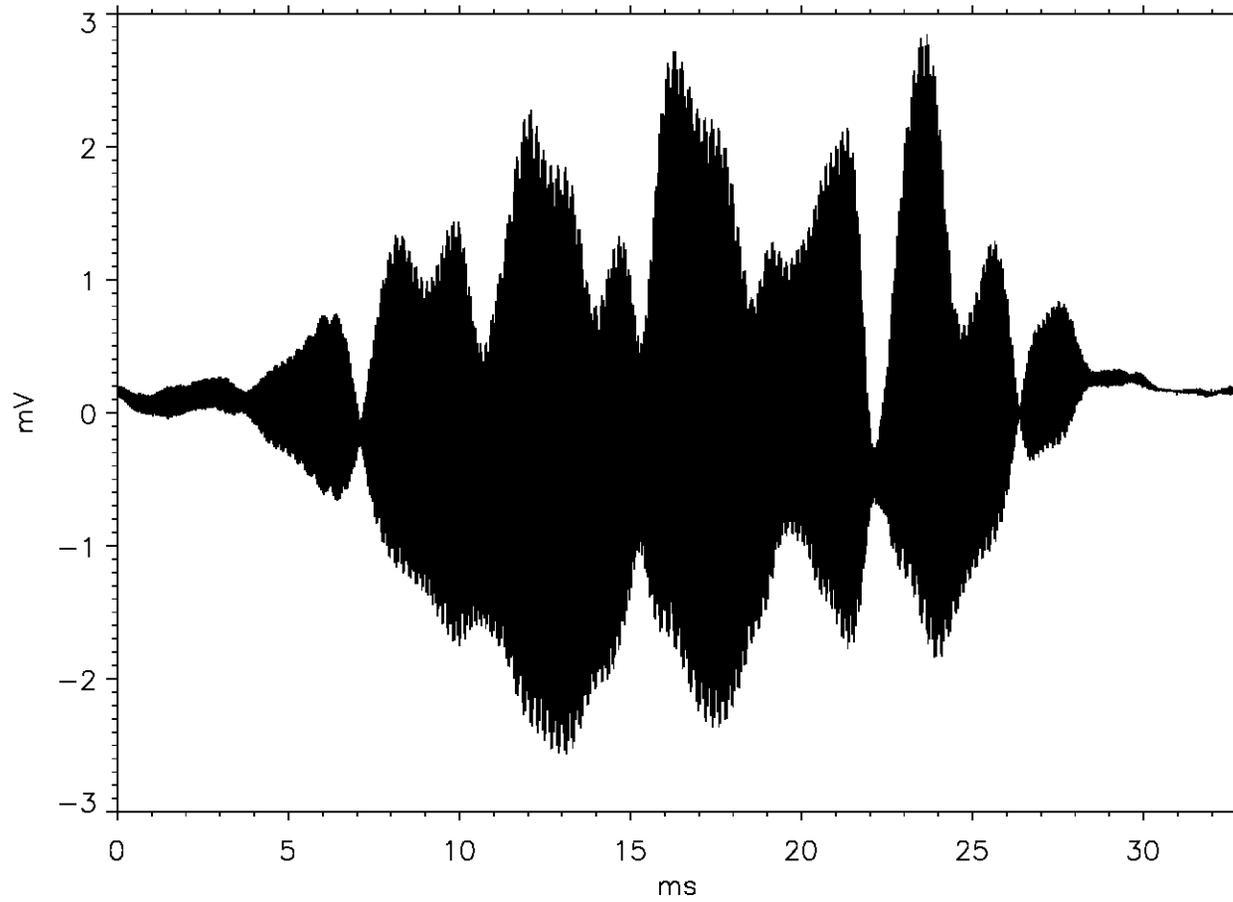
# ST-A, ST-B, Wind



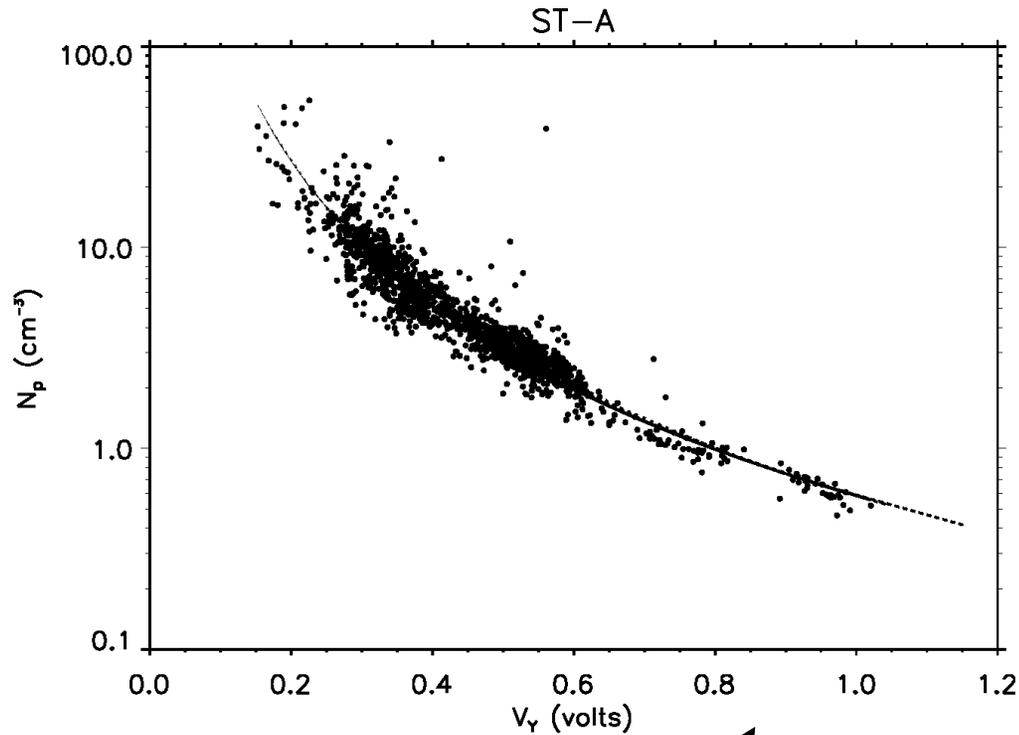
# S/WAVES antennas



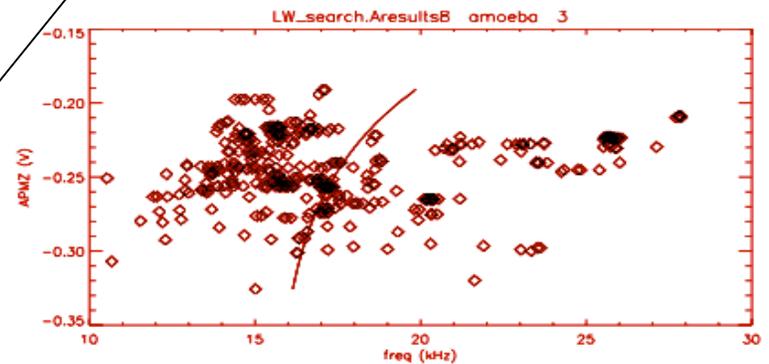
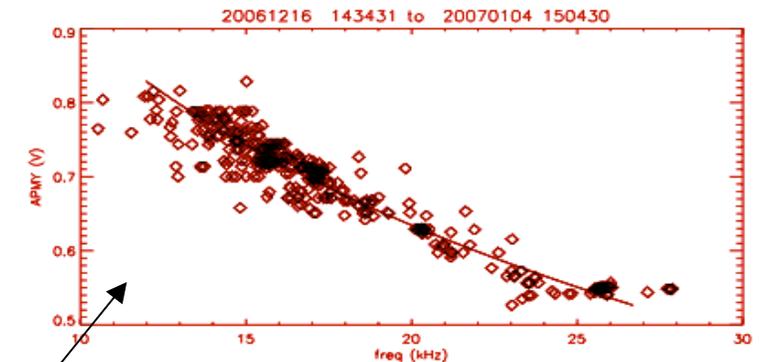
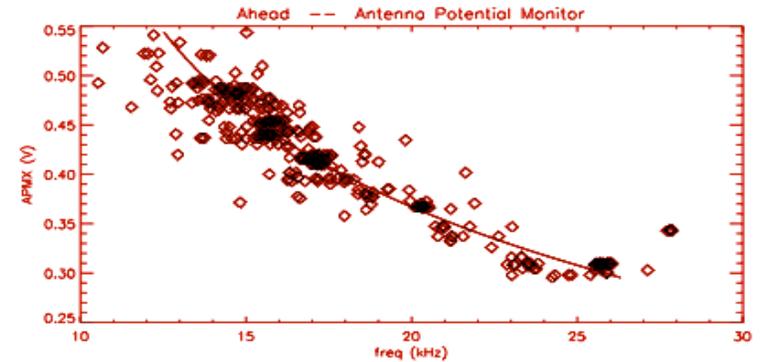
# Langmuir waves



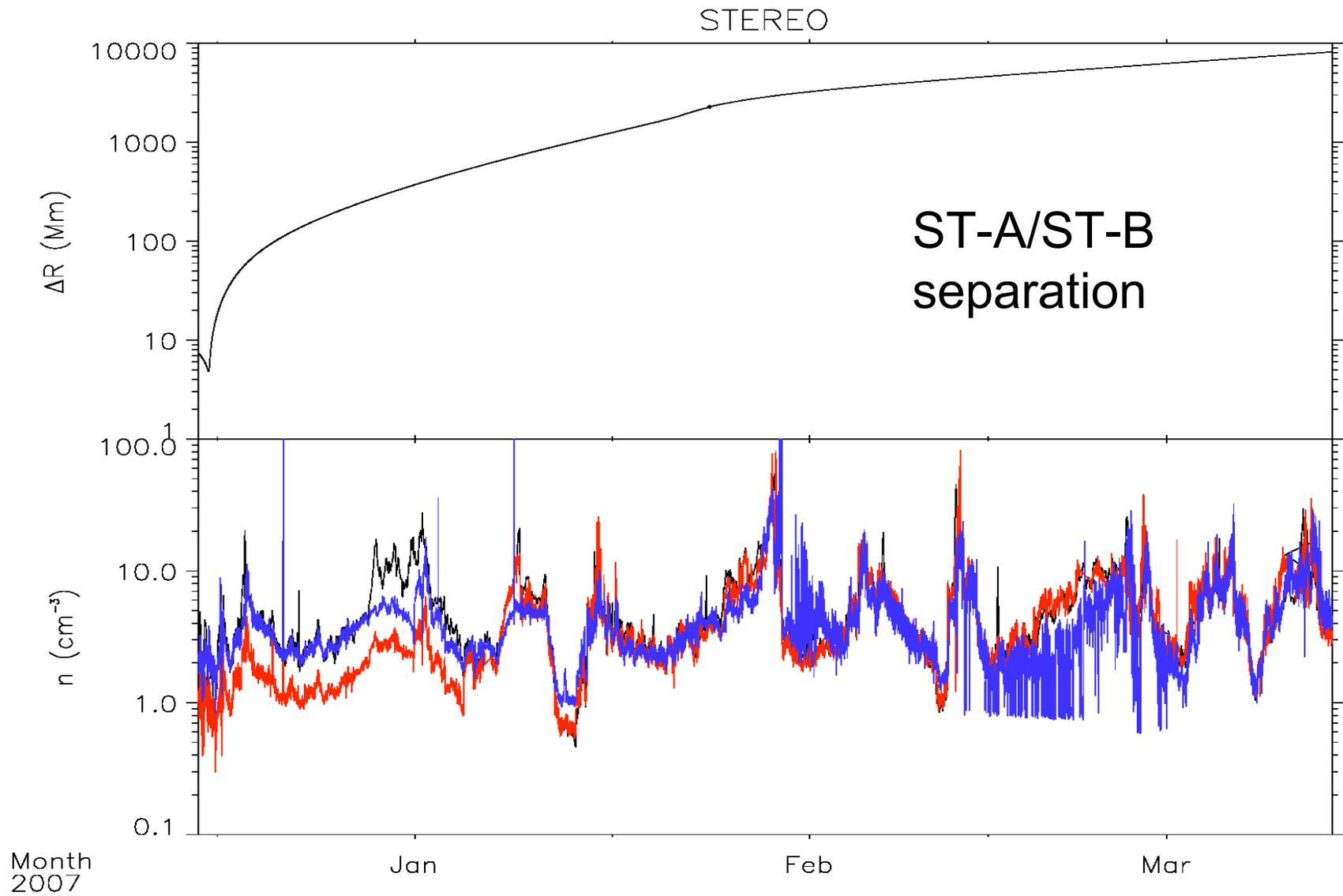
# Density/APM intercalibration



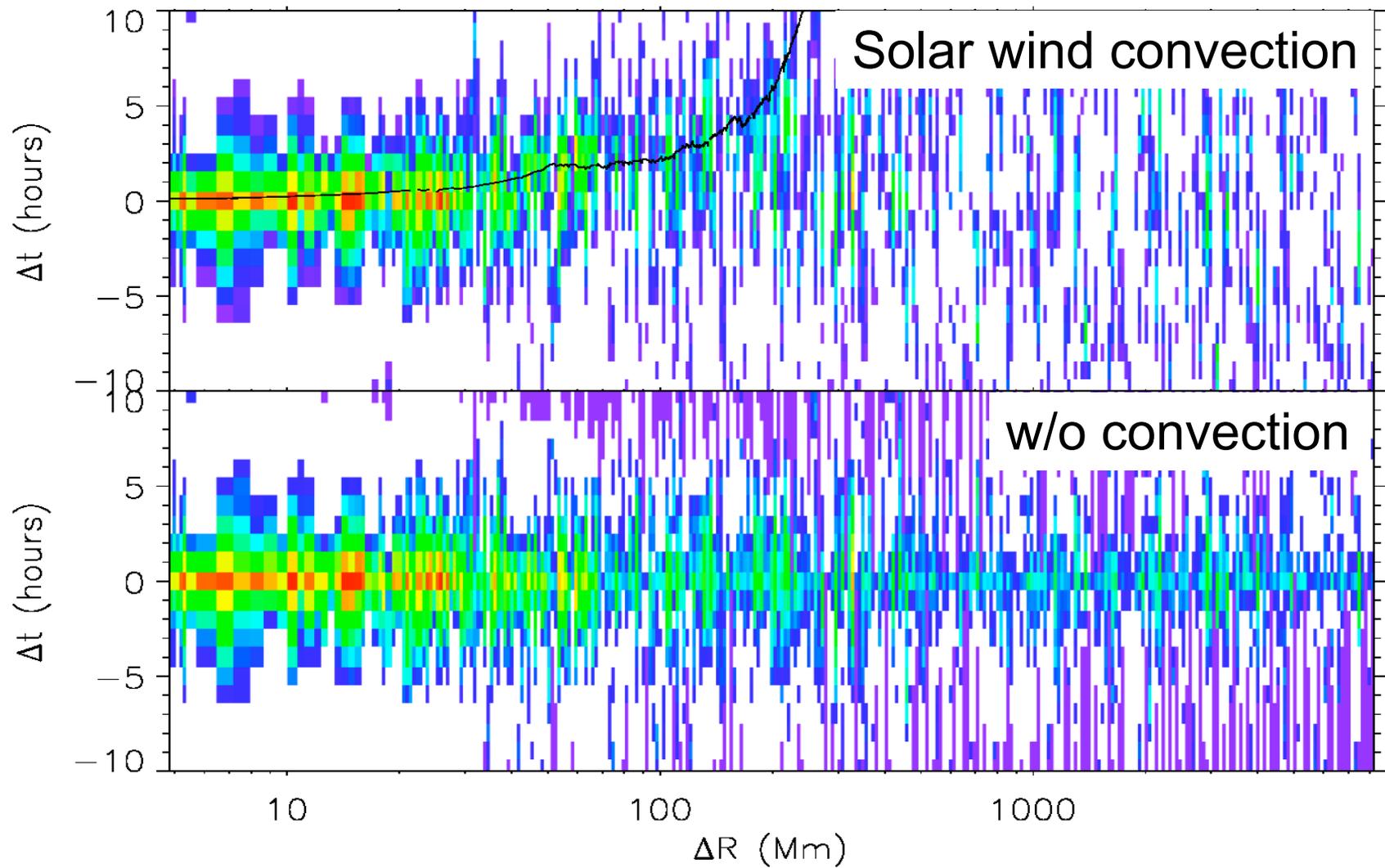
- APM vs SWE/ $N_p$
- APM vs Langmuir waves  
Dispersion due to  $T_e$ ? HGA?



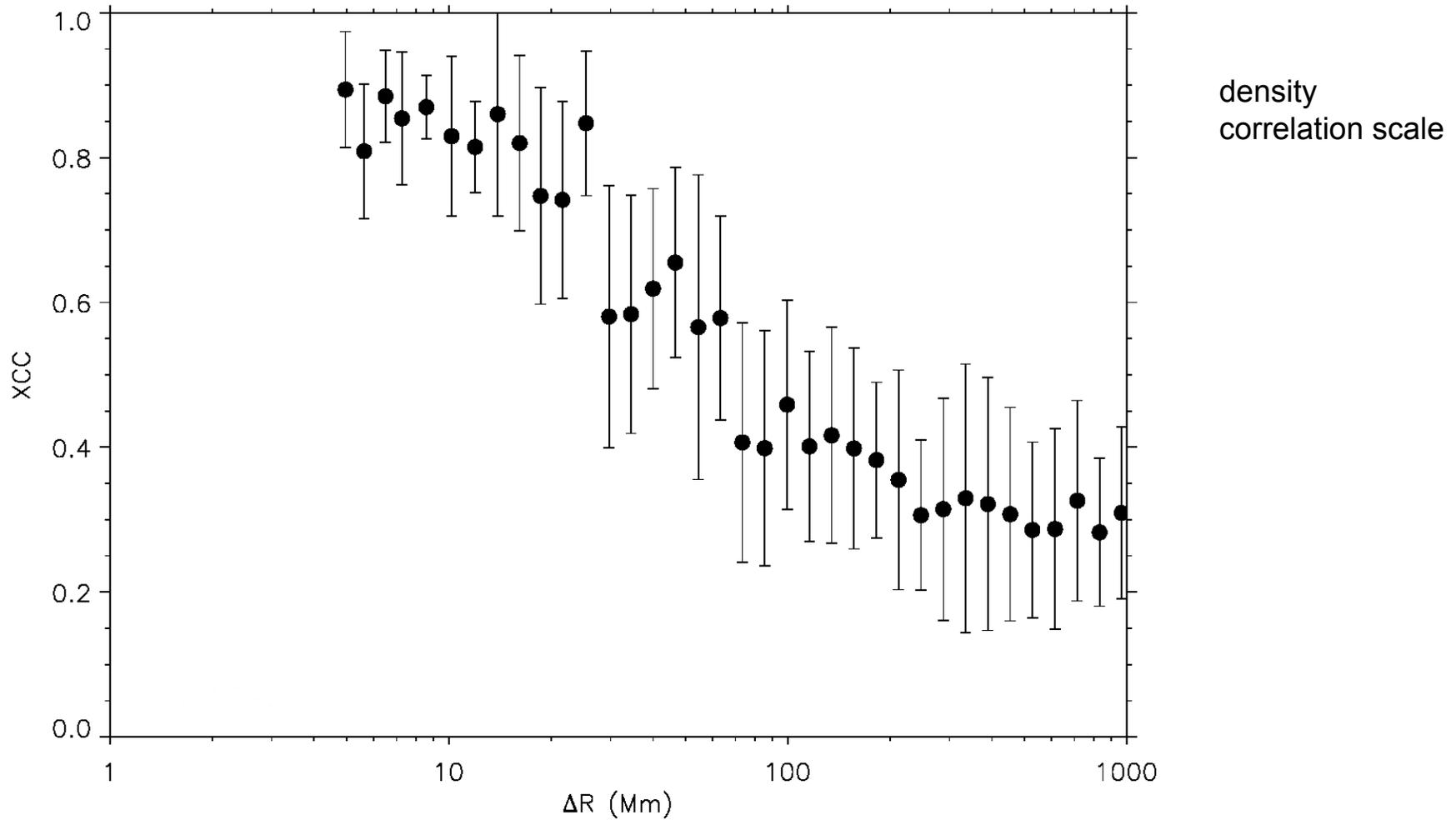
# S/WAVES APM densities + Wind $N_p$



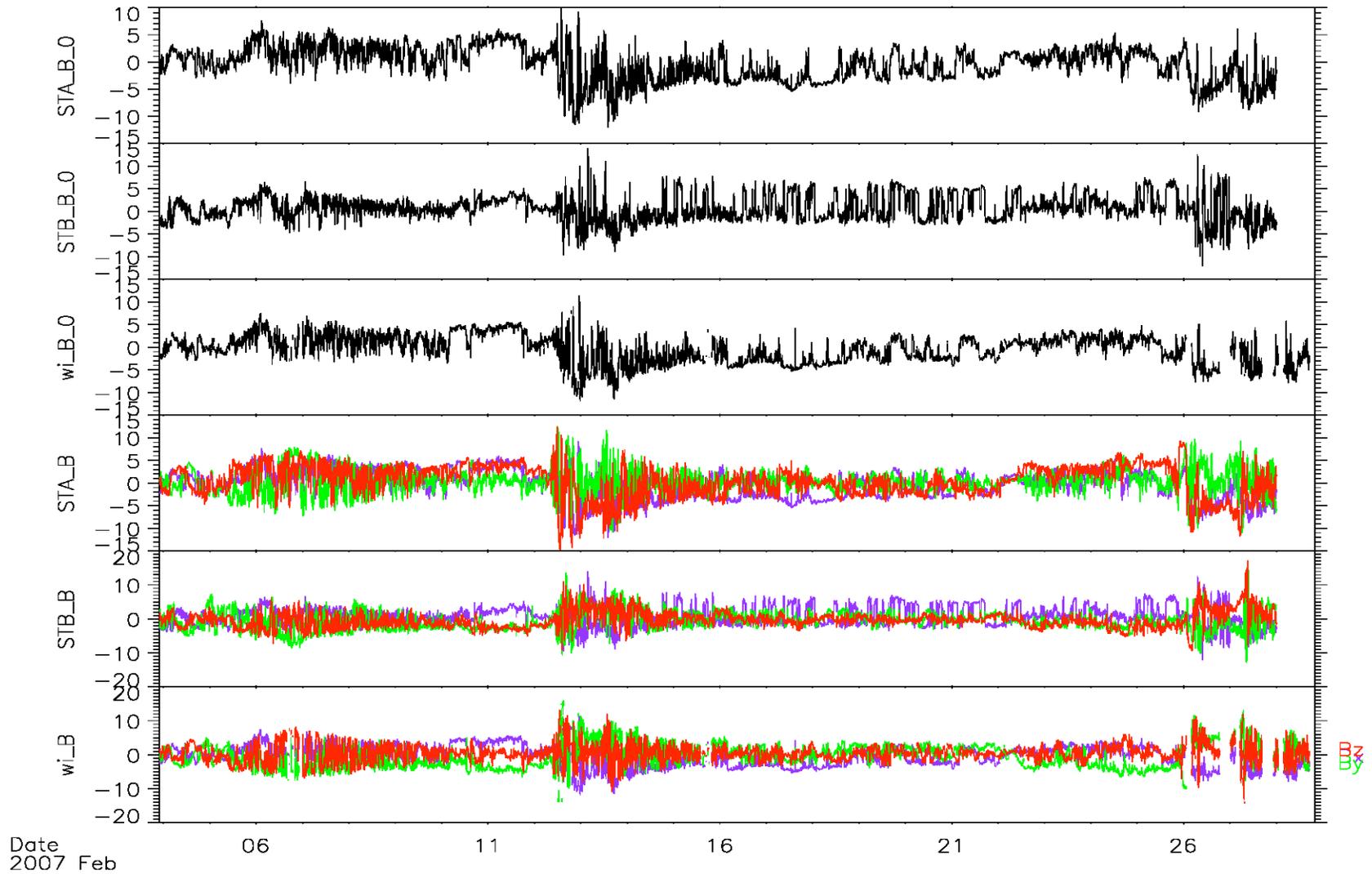
# XCC between A/B



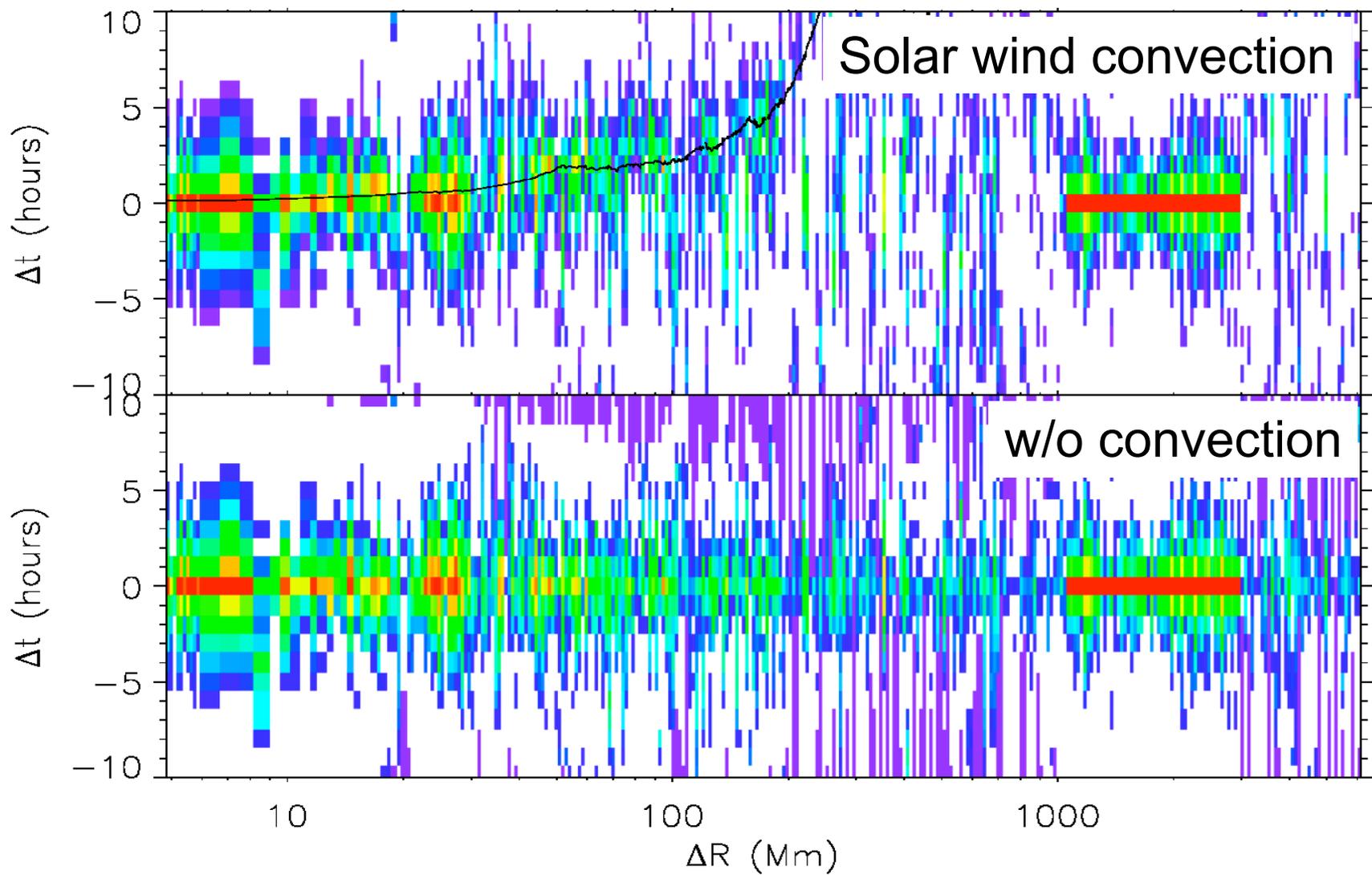
# XCC between A/B @ $\Delta t = 0$



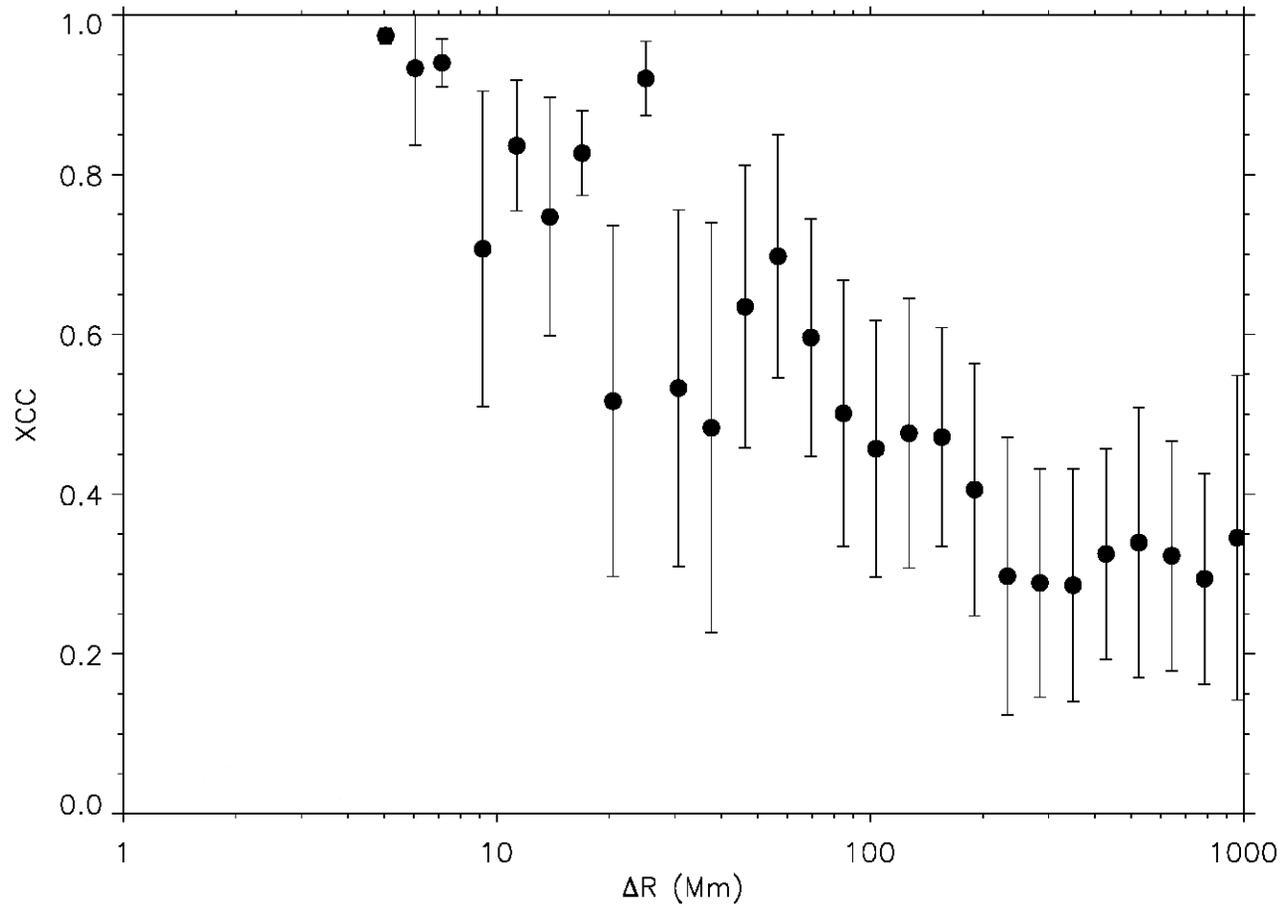
# ..same analysis w/ MAG



# XCC between A/B



# XCC between A/B @ $\Delta t = 0$



|B| correlation  
scale

n and |B| are passive  
scalars (compressive) -  
B components are different  
and interesting...

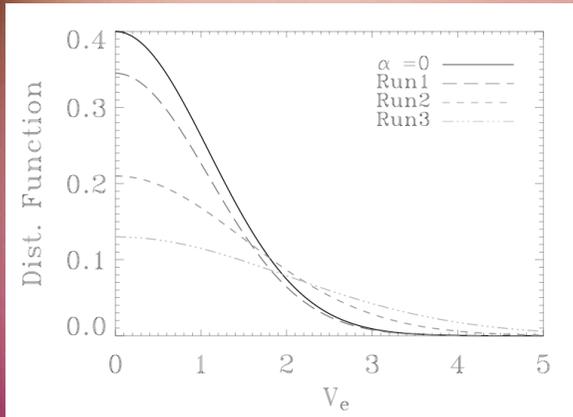
# Vlasov / TDS

## Some (preliminary) results

Carine BRIAND  
André MANGENEY

# Vlasov-Ampere :

localized time variation of e- Dist. Function



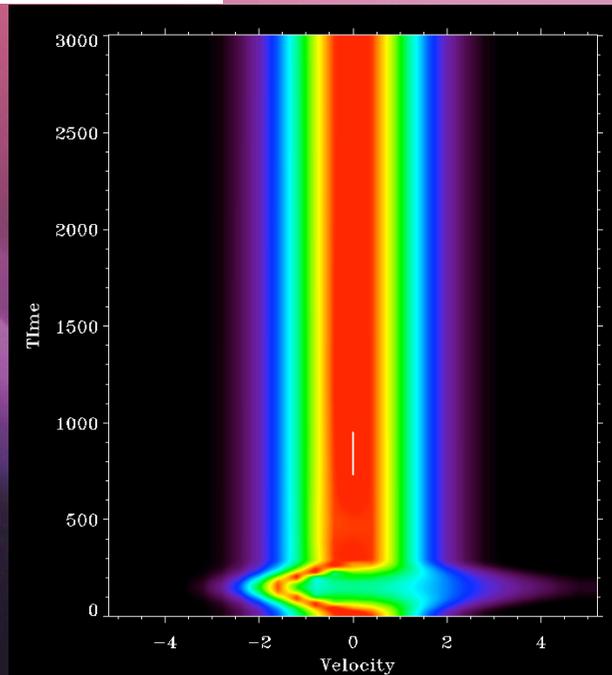
Electrons are heating in  $x=0$

Main parameters:

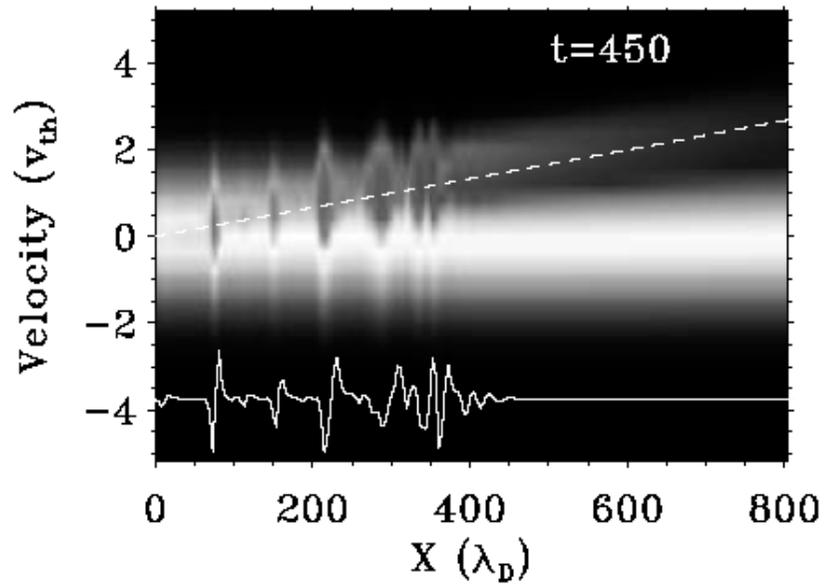
- Density gradient
- Proton to  $e^-$  mass ratio
- Proton to  $e^-$  temperature ratio

Several kinds of heating

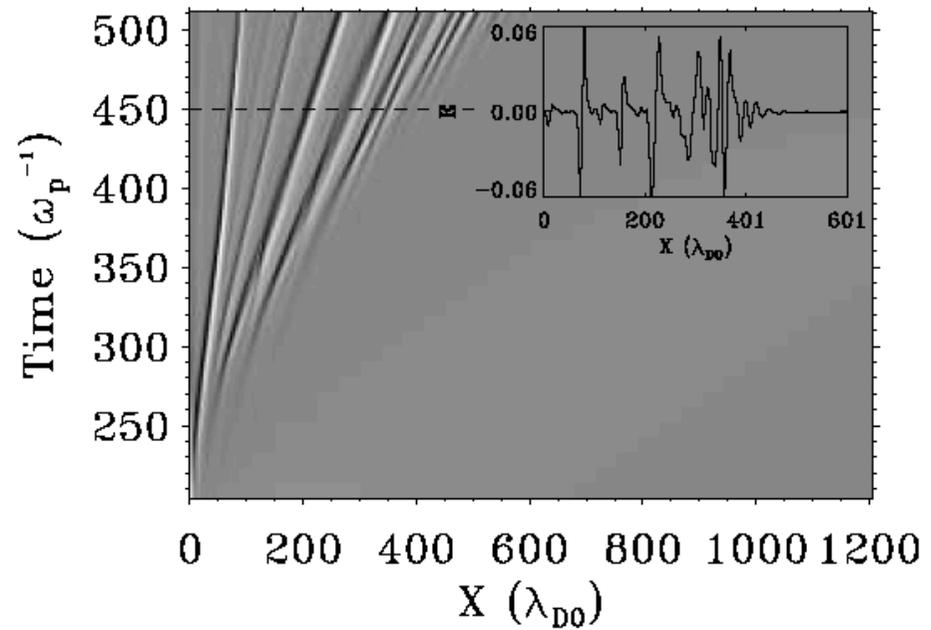
- 1 pulse;
- Several pulses;
- Continuous



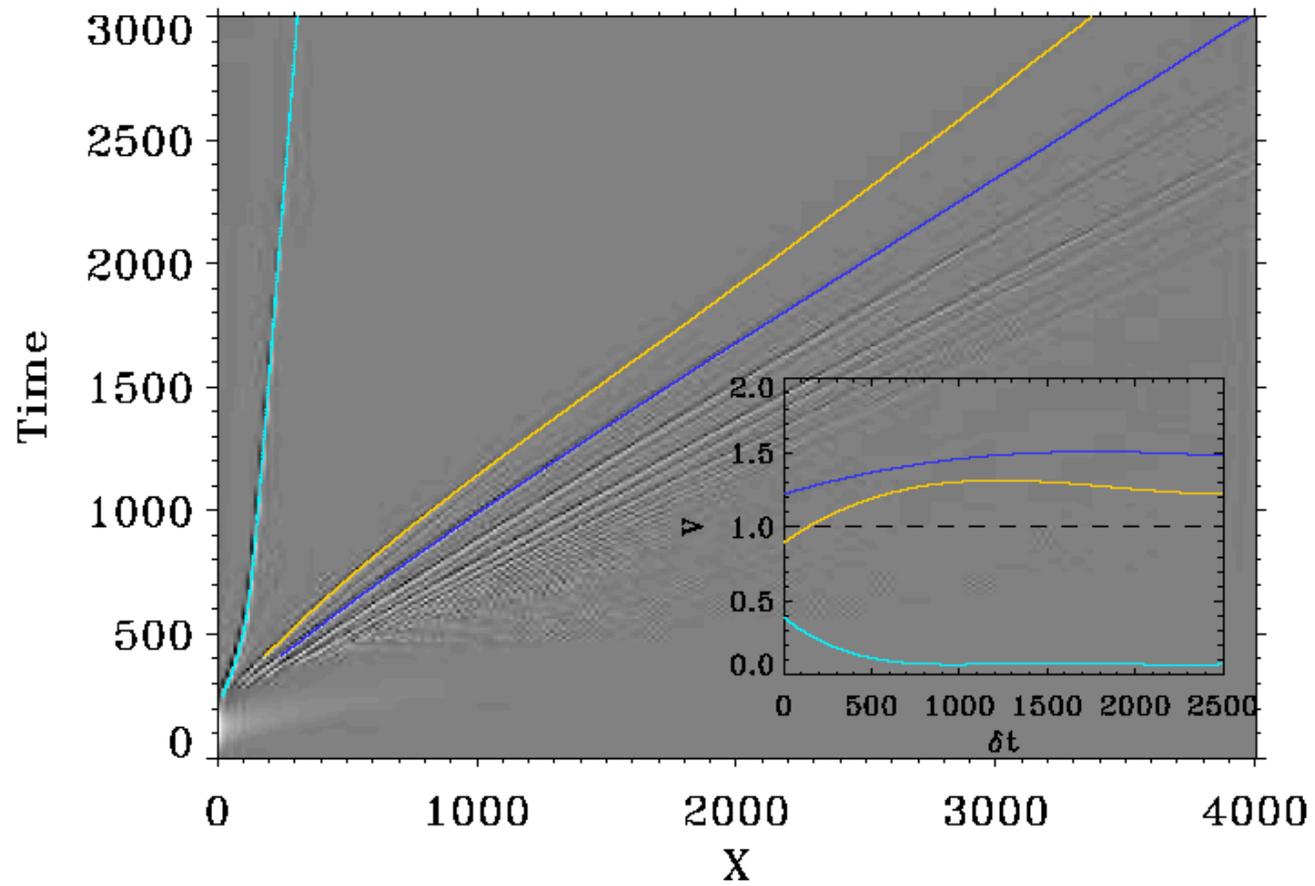
meeting  
agency

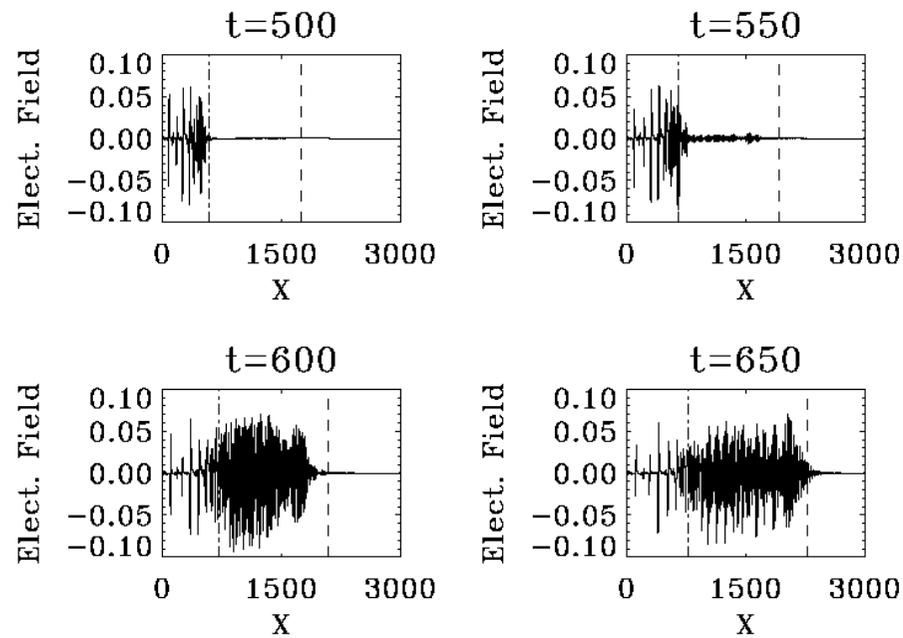


Vortex in the phase space  
Associated with solitary waves



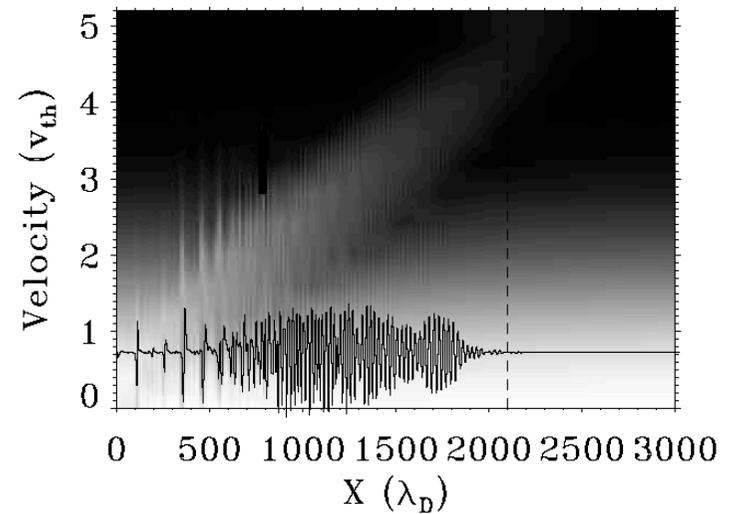
## Solitary waves velocity



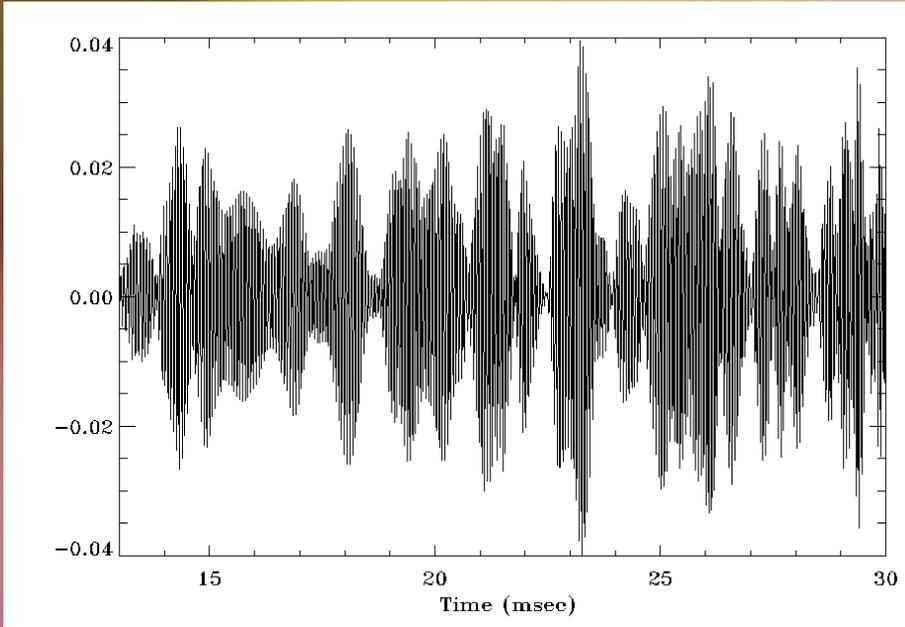


Non trapped e- lead to Langmuir waves

*(uniform density background)*



S/WAVES team meeting  
C. Briand/A. Mangeney

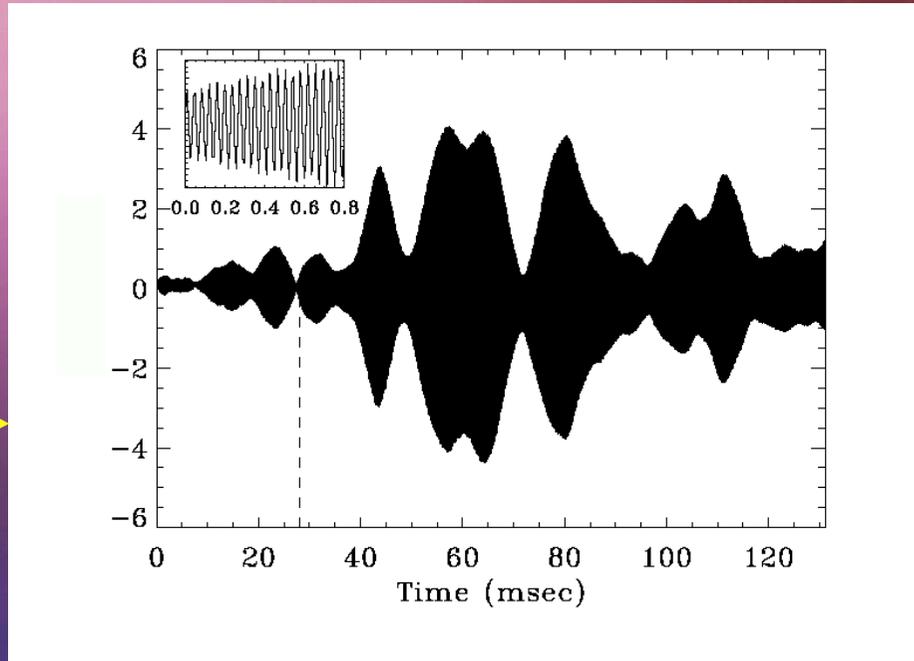


Clumpy aspect of Langmuir waves

VLASOV

No density fluctuations

STEREO  
"Quiet" SW

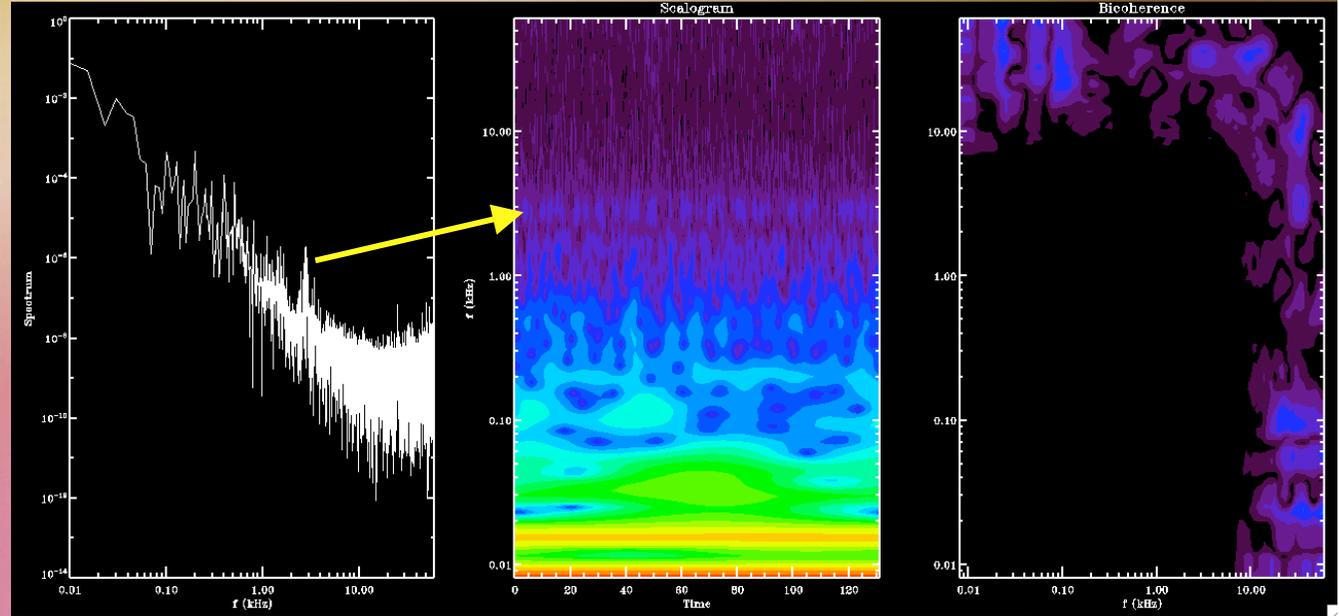
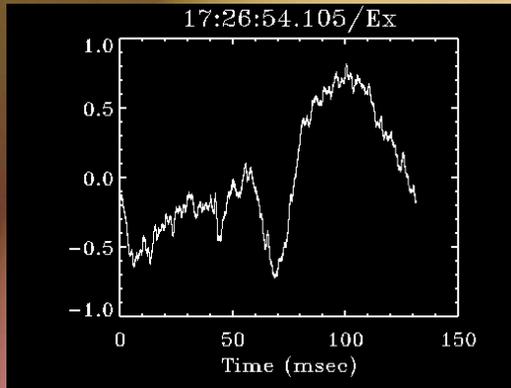


S/WAVES team meeting  
C. Briand/A. Mangeney

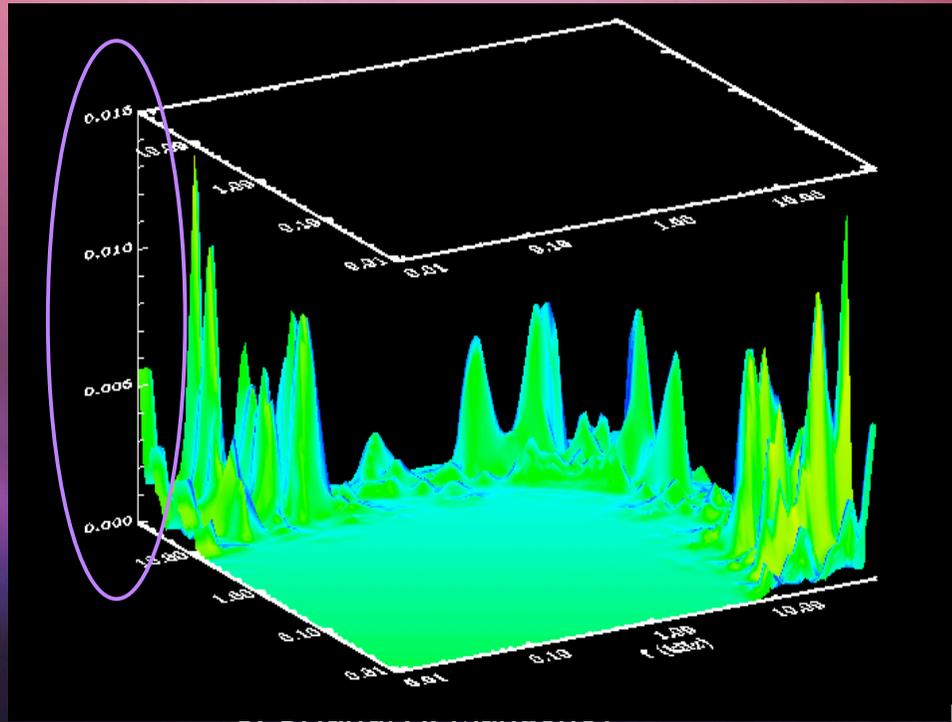
A background image showing a hand holding a smartphone. The screen of the phone displays a grid pattern, which is slightly blurred. The colors transition from a warm yellow at the top to a deep purple at the bottom.

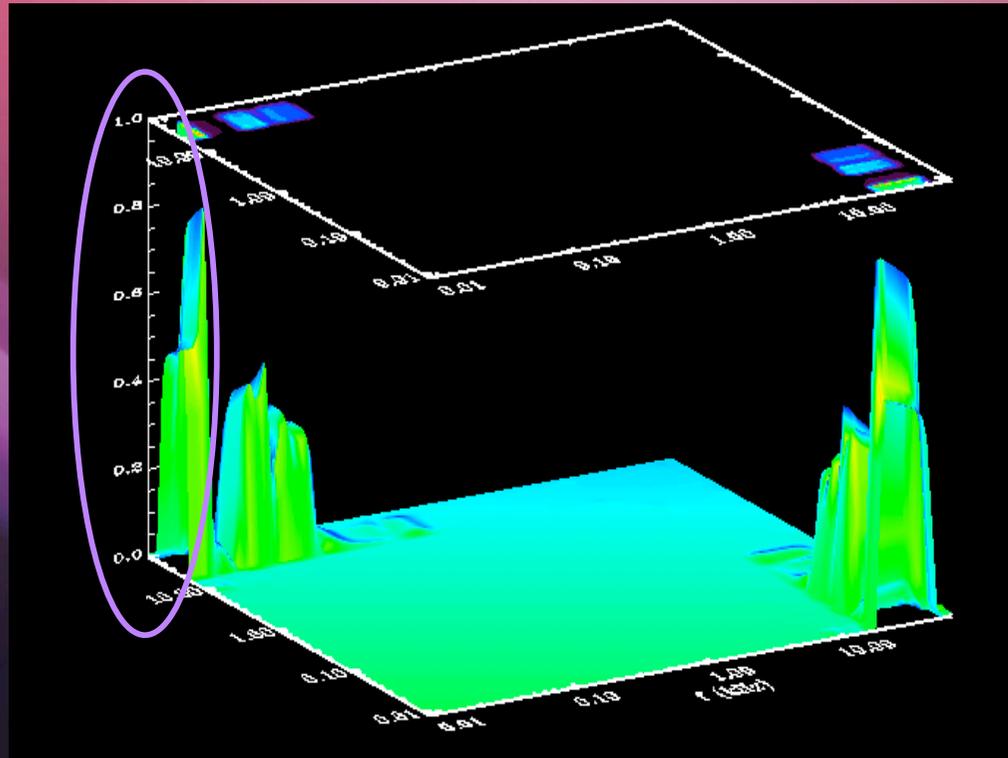
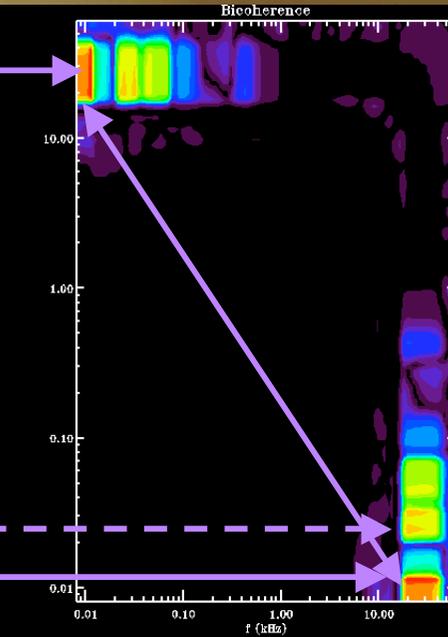
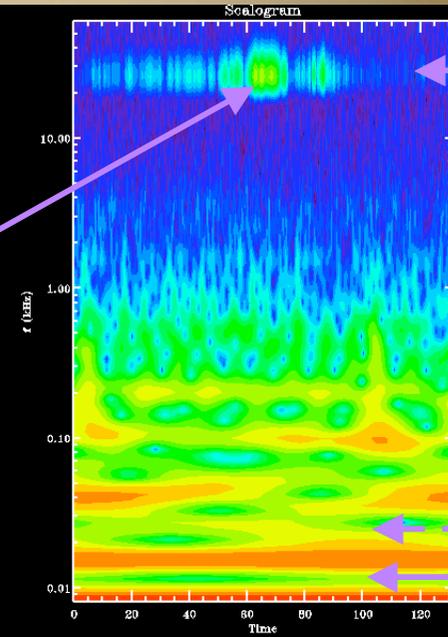
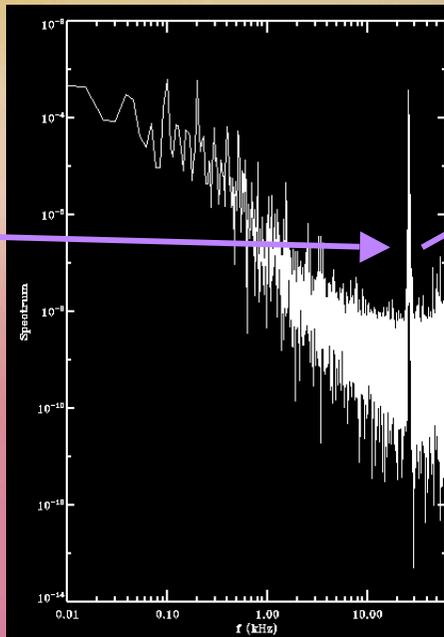
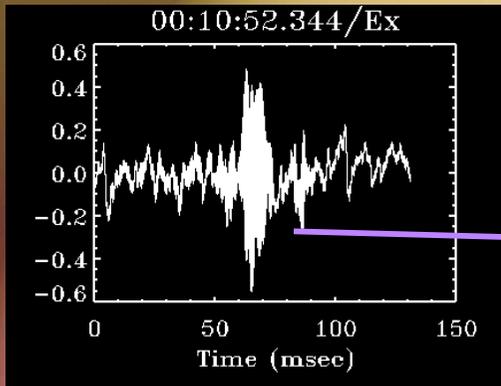
STEREO

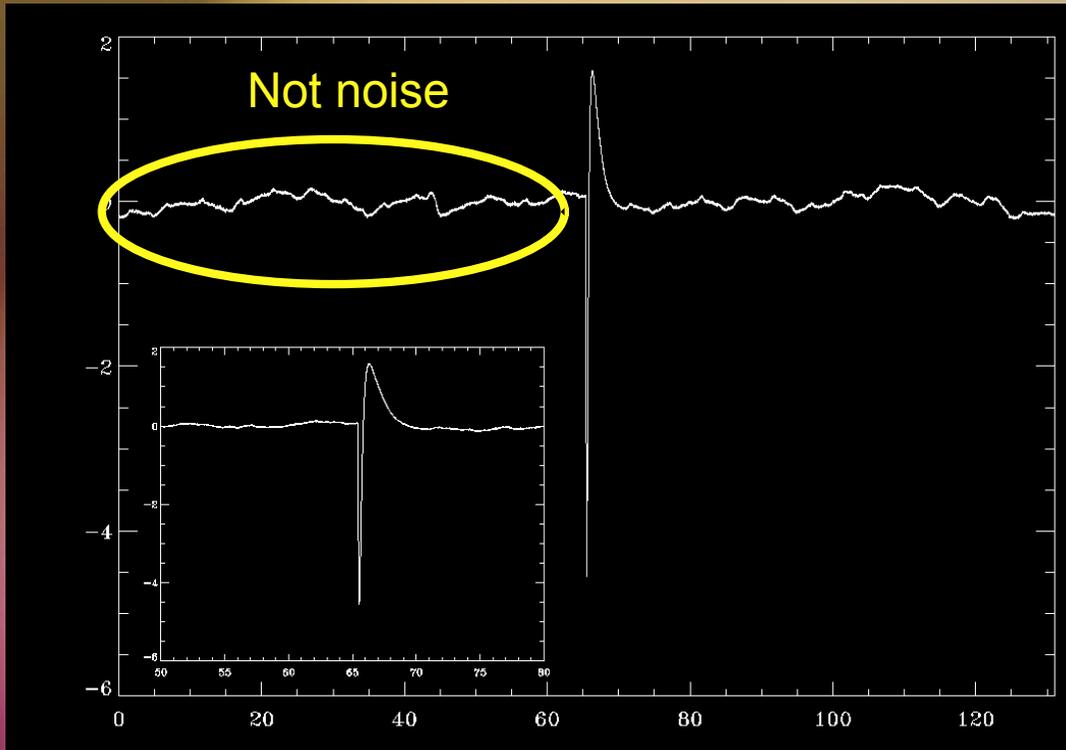
TDS



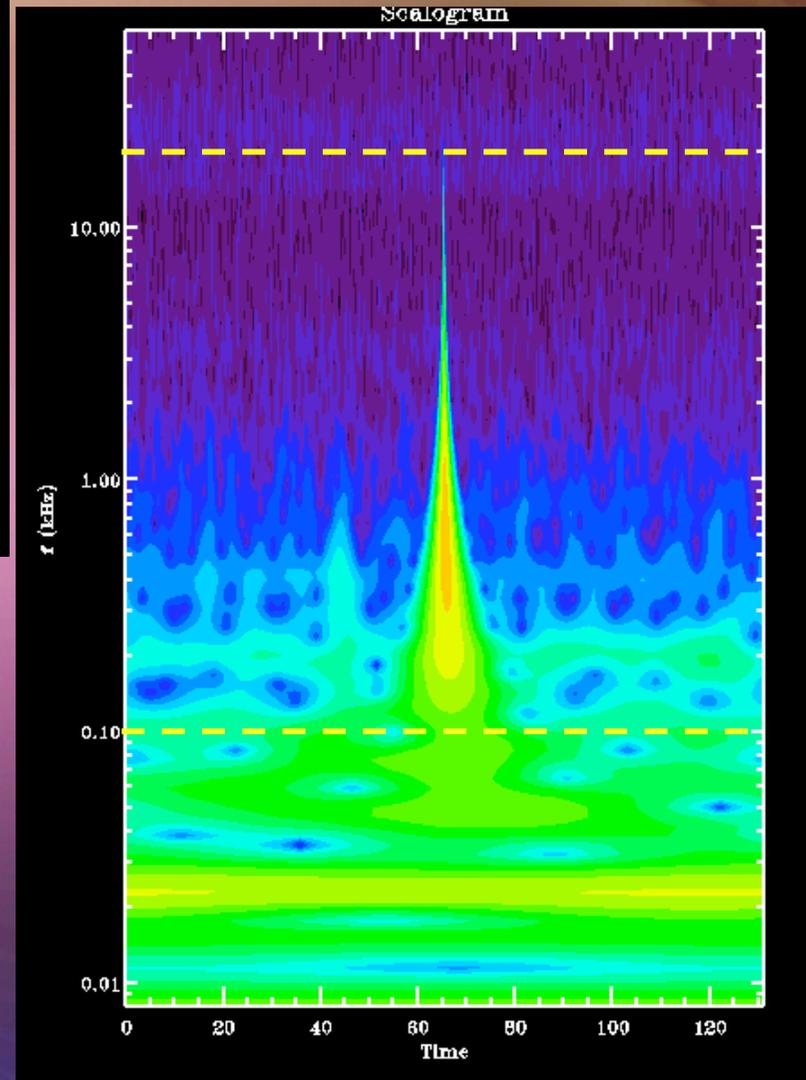
Bicoherency  
wave coupling

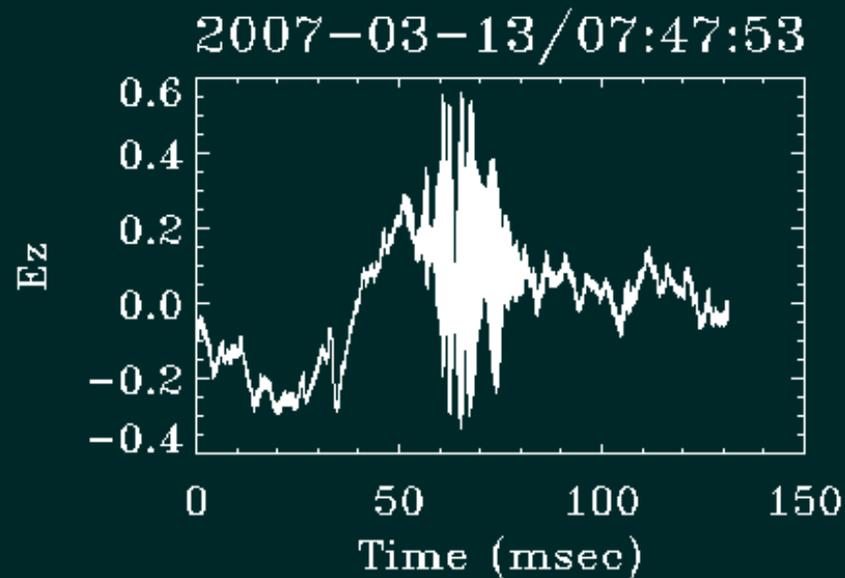
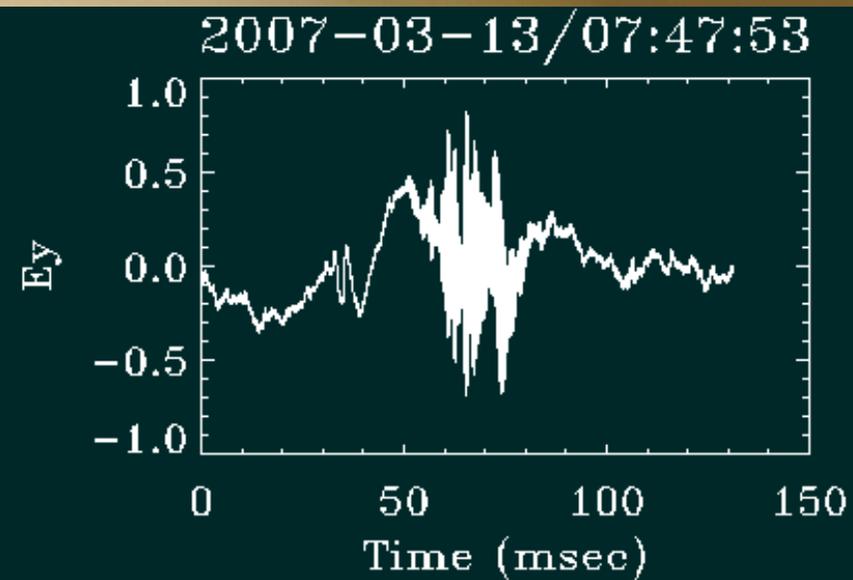
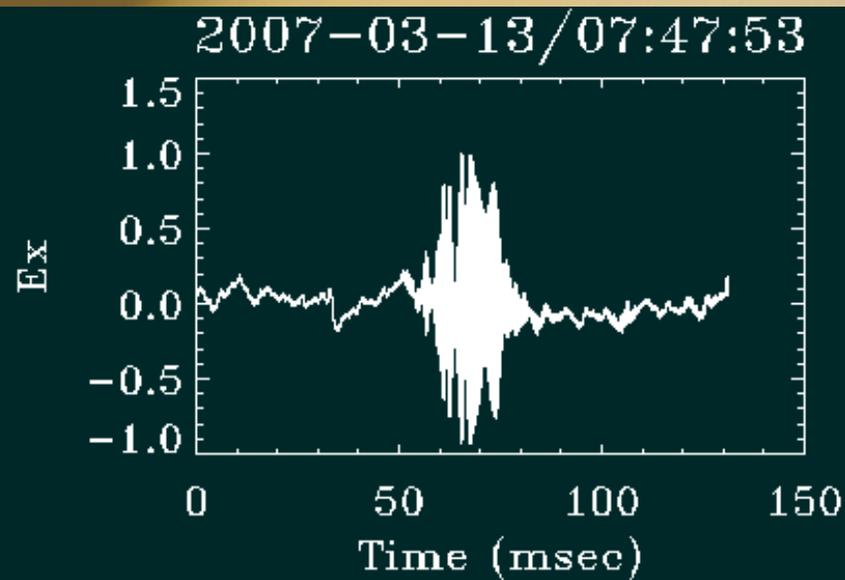


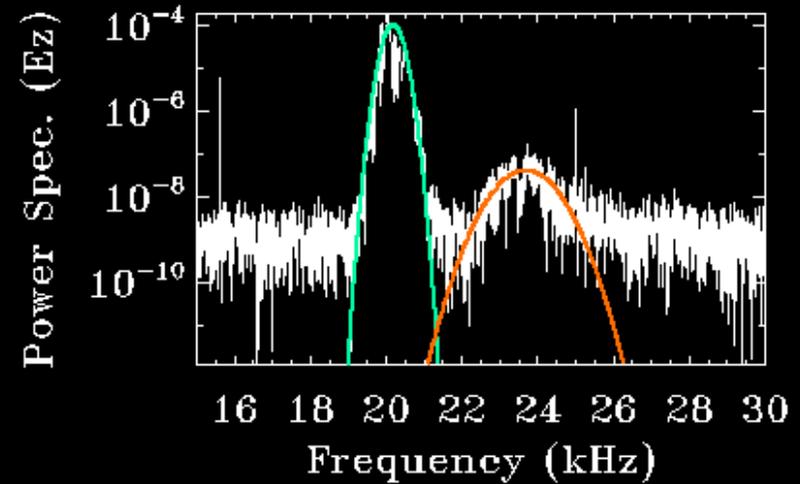
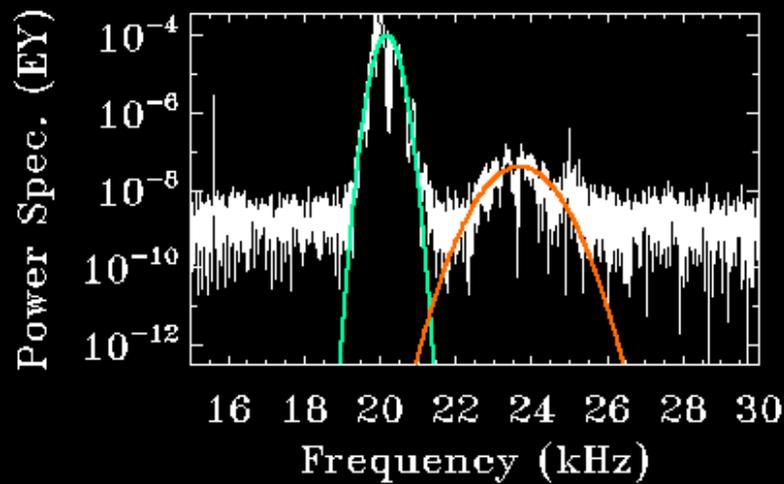
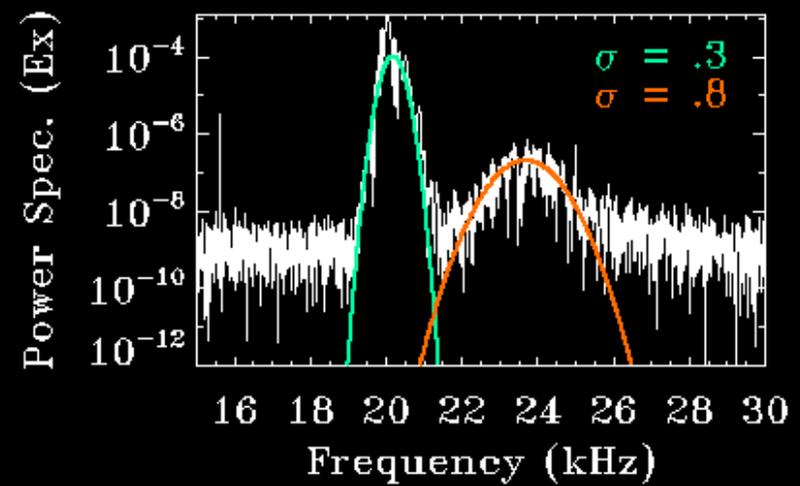
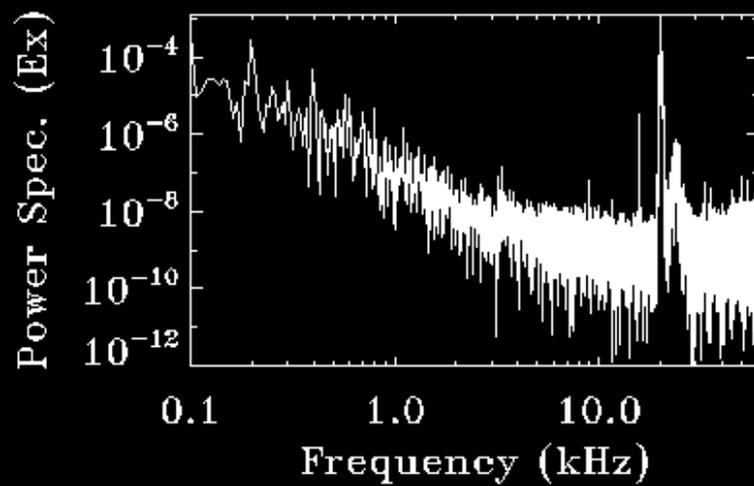




Still frequencies available !







Need for Ne and  $V_{sw}$  to go further

S/WAVES team meeting  
C. Briand/A. Mangeney



*National Museum of the American Indian*

S/WAVES team meeting  
C. Briand/A. Mangeney